FRUIT TREE AND GRAPE VINE PRUNING.

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COIMBATORE

A HANDBOOK

FOR

FRUIT AND VINE GROWERS.

Working under Climatic Conditions Prevailing in Temperate Australia.

488

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COIMBATORE

BY

GEORGE QUINN,

CHIEF HORTICULTURAL INSTRUCTOR, DEPARTMENT OF AGRICULTURE,
SOUTH AUSTRALIA.

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FRUIT TREE AND GRAPE VINE PRUNING.

INTRODUCTION TO THE SEVENTH EDITION.

The previous half-dozen editions of this little book have been issued under the authority of the Minister of Agriculture of South Australia as Official publications.

Owing to the generous support accorded to the booklet by the fruit-growers and horticultural public in the various States of the Commonwealth, the Dominion of New Zealand, and as far afield as the South African Union, the sixth edition became exhausted more than a year ago. Since then numerous inquiries for copies have been made by booksellers and others from time to time. Notwithstanding this assured demand, the Government of this State, owing to the financial stringency, has been compelled to abandon their intention of making a further reprint of the work.

The author is indebted to the present publishers, Robertson & Mullins, Limited, of Melbourne, for coming forward and offering to reproduce the book in its present form—which is identical with that of the sixth edition—and trusts that the support of the public, so freely extended in the past, will be maintained in the future to reward them for their enterprise.

GEO. QUINN.

Horticultural Branch, Department of Agriculture,
Adelaide, South Australia, February, 1932.

FRUIT TREE PRUNING.

PART I.

SOME BASIC PRINCIPLES.

THE ORIGIN AND OBJECTS OF PRUNING.

Under purely natural conditions each kind of plant appears to grow with the one express purpose of continuing its individual species. To this end, on arriving at maturity, it produces seeds of its own particular kind.

While it is a far cry back to the species of wild fruits which primitive man plucked from the woods to satisfy his hunger, it is nevertheless to these we most certainly owe the luscious crops of our modern orchards.

It must not be for a moment imagined that to the pruner alone can be attributed all those advances which mark the progress of the various fruits from their state of wild acridity to the delicious flavors they now possess. The hybridiser, selector, and cultivator must share with the pruner such praises as our gratified senses may bestow.

The pruner has gone hand in hand with these experimenters, and doubtless the acquirement of such knowledge as is now possessed of this art has been a very gradual process indeed. As we observe in our modern trees, so it is possible to imagine the early cultivator noted the tendency of the fruits to become larger when his trees bore them in limited numbers. At that remote period possibly the increased quantity of the pulp of such fruits likewise attracted his attention. To produce by artifice what some accident of nature had demonstrated to be possible would most likely be his self-allotted task. As a result of such observations probably he discovered what appears to be the first suggestion in pruning, viz., reducing the number of fruits by plucking some of them away, so that those remaining should benefit. The natural observation that few or only inferior fruits grew upon the weakly shoots in the densely shaded thicket would suggest the thinning out of superfluous branches and twigs.

This first conception of the importance of light and air as factors in the healthy development of all plants probably paved the way to various methods of spacing or training the branches of trees. The power of discriminating between the various buds, and thus limiting the number of fruits by cutting away twigs carrying flower buds, would doubtless come as a result of the close observation attendant upon more intense cultivation. The training of trees upon economic lines must be accepted as the creation of a later period, and, in fact, may be claimed as a development of this utilitarian age.

To sum up briefly, the objects of this art are—

a. To increase the size, appearance, and quality of the fruit.
b. To secure regular crops over a long period.
c. To accomplish all of these upon the most economic lines.

It is sometimes advanced that pruning is opposed to nature and unnecessary. Anyone who carefully observes unpruned plants, however, cannot fail to notice how mercilessly nature represses portions of them, or rather permits their more favorably situated fellows so to do. Mankind does nothing more, but he does it upon a system which always gives the production of fruit and an equal distribution of natural opportunities foremost consideration. Pruning and all other modern practices in commercial orchards tend to place the fruit tree on a par with a machine which, within a given time, must not only earn interest upon its original cost and pay for upkeep, but must renew the capital necessary to replacing the machine.

That period may be termed the productive lifetime of the tree.

Profit first, artistic effect second, gigantic proportions, only so far as is consistent with the acquirement of the first named, should be the desiderata of the modern orchardist.

OBSERVED FACTS ON WHICH THE THEORY OF PRUNING IS BASED.

We have stated that the ultimate objects sought in pruning are to cause the tree to produce more regular crops, to improve the quality of the fruit, and, while doing so, maintain its vitality over a profitable period. We therefore apply this art—

a. To modify the form of the tree to meet economic cultural requirements, and to counteract unfavorable climatic conditions

b. To reduce or stimulate the production of wood growth or fruit bearing, as the case demands.

c. To remove injured or worn-out parts.

To accomplish these the pruner must take into consideration rules or laws which appear to almost invariably operate in the growth of plants. Those of primary importance may be set out as follows:—

1. *The vigor of a plant or of a shoot is dependent on the leaf surface upon it.*

Considering that the leaves are practically the lungs and stomach of a plant, this statement is tantamount to saying that the plant which has the largest transpiring and assimilating capacity must, when food is unlimited, be the strongest grower. This law has a particularly important bearing upon all pruning operations performed whilst the tree is in a state of vegetative activity.

2. *The nearer a shoot approaches a vertical position the stronger will be its growth.*

This is founded on an unvarying law of nature, by virtue of which the sap in plants flows most freely to the highest point of each shoot.

3. *The nearer a shoot approaches a horizontal position, so its vigor diminishes.*

This is only a natural corollary to the previous statement. These two rules have a most important bearing upon the selection of shoots required for wood or fruit production. Vertical shoots usually run to wood alone, while those tending towards a horizontal plane turn to fruitage. This goes to show that fruit-bearing is an attribute of moderate weakness rather than of great vigor.

4. *The lesser the number of buds upon a branch the stronger will be the growth made by each individual shoot arising therefrom.*

This may be put in other words, indicating that heavy pruning of the top tends to increase the production of strong wood growth. Under natural conditions of growth there is a balance between root and top. They mutually nourish each other, but when suddenly the top is reduced —without the interference of disease—the remaining buds make haste to utilise the extra volume of sap sent up to them. Partly for this reason, when pruning newly-set trees the number of buds is reduced by pruning away a large portion of the top shoots.

5. *If the root system be reduced the vigor of the top growth will be correspondingly diminished.*

It is this fact which causes gardeners to prune the roots of rank-growing, unfruitful trees. Again, when young trees are removed from the nursery beds, many roots are broken off, or damaged so as to necessitate their amputation. To effect a balance the top must be curtailed, otherwise stunted growth or decay will result.

6. *When a number of shoots are growing at different levels upon the same plant, generally the topmost shoot absorbs most sap, and outgrows those below.*

This is seen in every tree, and gives rise to the practice of pinching the growing points out of the highest shoots on young trees, so as to lessen this natural advantage.

7. *Deformations of any kind, such as those produced by wounds or compression of sap vessels, diminish the activity of vegetation of plants, or of those parts situated above them.*

The correctness of this statement is clearly shown in the effects produced by cinctures, bruises, large wound scars, partial fractures, or the hardening of the bark, consequent upon the sun's rays being permitted to shine directly upon it in the summer.

8. *Within certain limits, the fruit production of any plant or shoot diminishes with increased activity of its vegetation.*

In other words, when a mature tree is forced into making vigorous growth, its production of fruit is lessened. Again, young trees, when properly nourished and trained, do not fruit freely until they have assumed considerable dimensions and contain branches, usually growing in a lateral situation, which make weakly growth. This also points to the fact that the fruit-bearing habit arises from a quiescent condition in the plant or branch. To quote an extreme case, a superabundant crop of oranges is usually regarded as a sign of the tree having begun to decline.

9. *The smaller the number of fruits the better their quality and size.*

This is the chief reason why fruitgrowers thin their crops at an early stage of development. Pruning, also, is utilised to the same end. By judiciously thinning out the fruiting wood the possible number of fruits is lessened, and each one retained receives a larger share of the plant food elaborated.

THE SEASONS FOR PRUNING.

The season of the year during which pruning should be done depends very much upon the object immediately in view.

I.—WINTER PRUNING.

WINTER PRUNING, which is practised when the wood has ripened and the leaves have fallen from deciduous trees, is usually looked upon as most important. In the first place, when the tree is devoid of foliage, the pruner can see clearly the position of each branch, spur, or bud, and weigh its present use or calculate its future value. It usually happens, also, that he has more leisure to carry out the work at this season of the year. *The general effect of pruning performed during the dormant period is to stimulate increased growth when the season of vegetative activity returns.* We can therefore assume that winter pruning may be calculated to directly ensure wood production rather than fruition. Winter pruning is consequently of greatest value in shaping young trees or renovating older specimens which lack vigor It must not be inferred from this that only the wood making—the timber building—parts of the tree are to be pruned in winter. The amount of reduction, and the proportion of the buds into which the energies of the tree will be concentrated thereby, usually regulate the intensity of the after effect. The pruner will see, therefore, that in dealing with a healthy established tree which has developed a good spur system, only very light annual winter prunings are required, otherwise the general habit of the tree may be disturbed over a considerable period of years.

II.—SUMMER PRUNING.

SUMMER PRUNING is a term used to define all those operations which are performed upon the tree while it is in a state of vegetative activity. *Any reduction of the green parts of a tree, when it is growing freely, tends to administer a check more or less severe, because it suddenly removes some of the absorbing and elaborating surface.* The hardening of the bark which follows upon the admission of strong sunlight also has a stunting influence, because it retards the flow of sap to the extremities of the branches. It has been indicated in the preceding chapter that the fruit-bearing habit is one of the results of a quiescent condition in the tree or branch rather than of great vigor. It is owing to the recognition of this that summer pruning has been utilised to induce the fruiting habit in trees of strong growth. The stage of the summer or growing season at which the work is done has an all-important bearing upon the results. If the reduction be performed in early summer, the check is very temporary. This ends—unless repeated—in producing an effect almost akin to that of winter pruning. The portion pinched or cut heals up the wound and grows again rapidly. This early application of summer or green pruning is extremely useful in giving a temporary check to a vigorous shoot which threatens to upset the balance of a young tree by outgrowing its fellows. It is also of value in wholly removing portions of the tree to admit abundance of sunlight, and thus allow of

the proper development of more desirable lateral fruit-bearing growths. To become a factor in changing the character of the shoots, it should be performed after mid-summer, when the supply of water slackens and the elaboration of sap gradually subsides. It is then the sap appears to settle slowly into the extremities of spur and branch and stores the buds with food material without forcing them into active development.

PRUNING TOOLS AND HOW TO USE THEM.

Every wound upon a fruit tree should be regarded as an evil, and consequently, whenever it is necessary to inflict a wound upon a tree it should be made in such a manner as will permit it being healed over in the shortest time possible. The season at which the pruning is done must of necessity be considered, and this will be treated in a subsequent chapter. Wounds which are caused by a clean cut heal more rapidly and perfectly than those that are bruised at the margin. It follows, therefore, that pruning tools must not only be kept in a sharp and clean condition, but must be used with due care and precision. In some countries various kinds of hooks and tomahawks are used, but as a rule, unless skilfully handled, they are a source of lasting injury to the trees. The tools recommended to be used in pruning are knives, pruning shears (secateurs), and saws.

I.—KNIVES.

The section made by a sharp thin-bladed knife is as near perfection as any wound could be. A good pruning-knife should have a thin blade of finely tempered steel, admitting of the receipt of a very keen edge. The outline of the cutting edge should be concave, whilst that of the handle on the same side convex, making, in combination with the blade, a fairly regular compound curve. The handle ought to be strong and preferably longer than the blade, and thick enough to enable it to be held firmly without turning in the hand when under heavy pressure. The rivet holding the blade and the back spring supporting it must both be stouter than those fixed in ordinary pocket-knives.

Although almost superseded by the pruning shears, the pruning knife still retains a place in the outfit of the orchardist. In pruning the lacerated roots of young trees; in smoothing over the edges of rough saw cuts or torn sections on wind-broken limbs; or finishing off the rough ends made by the secateur in forks and sharp angles, its aid is absolutely necessary. In pruning the leading shoots of young trees for the first year or two, before they have become very numerous, it is to be recommended on account of the cleanness of its wounds.

The knife should be used with a drawing motion towards the operator. If the shoot is thick enough to offer much resistance, see that the edge at the base of the blade enters the bark first, thus presenting a longer cutting face to the limb as it is drawn through. When severing an annual shoot the blade should enter the bark from the side opposite to the topmost bud which it is intended to preserve, at a point on a level with the top of the bud, and emerge just far enough above to avoid injuring it. Care is required to prevent the blade slipping through the pruned shoot and cutting into others which the pruner desires to keep intact. In Fig. 1 (1) represents a knife of the celebrated Saynor type, which the writer can confidently recommend to fulfil all average requirements.

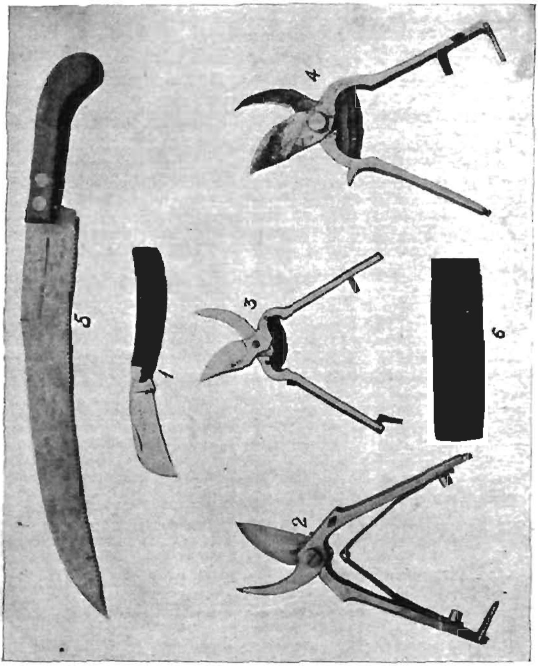


FIG. 1.—PRUNING TOOLS.

(1) SAYNOR PRUNING KNIFE.

(2) "SALADIN" SECATEUR.

(3) "BOKER" SECATEUR (SMALL SIZE).

(4) "MEXEUR" SECATEUR.

(5) "WINGFIELD" PRUNING SAW.

(6) OILSTONE, "TURKEY SLIP."

II.—PRUNING SHEARS, OR SECATEURS.

The best makes of pruning shears possess a strong framework, *i.e.*, handles, hook, connecting bolt, and blade, which refuse to bend under very great pressure. This is always a good test for inferior cheap brands of shears. The handles should be sufficiently shouldered to avoid the possibility of the hand of the operator slipping forward to the vicinity of the bolt when they are widely expanded, and again, when they are closed, some projection between the handles is desirable to receive the shock of their coming together, otherwise the hands of the user will probably suffer from pinching. The bolt ought to be adjustable by means

FIG. 2.—HOW TO HOLD THE SECATEUR WHEN SEVERING A SHOOT.

of a screw nut, so that the alignment of the blade and the hook may be corrected from time to time. The hook must be exceedingly stiff, and to secure this many good shears have a flat piece of hard steel brazed on to the inner side of it. The blade in all good types is removable, and may be replaced by a new one costing about a shilling. The blade should be made of well-tempered steel and possess no shoulder, viz., from the cutting edge to the back of the blade must be completely bevelled, and kept so by judicious sharpening. A thick abrupt shoulder exerts a strong lateral pressure upon the tissues of the shoots, bruising them for a considerable distance.

Fig. 1 shows three different secateurs. (4) is a fine strong kind of 9in. secateur made by Mexeur & Cie. Chatellerault (France). This is a good tool for the hard pruning of winter. It will sever green shoots up

to 1in. in diameter without straining. (2) represents the well-known "Saladin" secateur in the 9in. size. (3) is a handy instrument, made by Henry Boker, Germany, this type is very useful for light top work in winter, and likewise for summer pruning. It is placed at a disadvantage, however, for, unlike the other two, the blades cannot be replaced. Some pruners have a deep-rooted dislike to the secateur, averring that it bruises

FIG. 3.—SHOWING POSITION OF THE SECTION IN RELATION TO THE BUD.

the shoots. This is probably correct if cheap inferior grade tools are used. In shears made from inferior materials the fine edge necessary to achieve good clean work cannot be retained, if it is ever really obtained. Again, much of the bruising done is due to the manner in which the hook and blade are brought in contact with the shoot to be severed. The action of the pruner when closing the shears is also of importance. If we examine the secateur, it is seen to be composed of two parts, held together by a bolt, and terminating at one end in a pair of handles. One side carries a blade with a *convex* edge; the corresponding end of the other part is comprised of a *concave* steel-edged curved holder or hook. When a branch

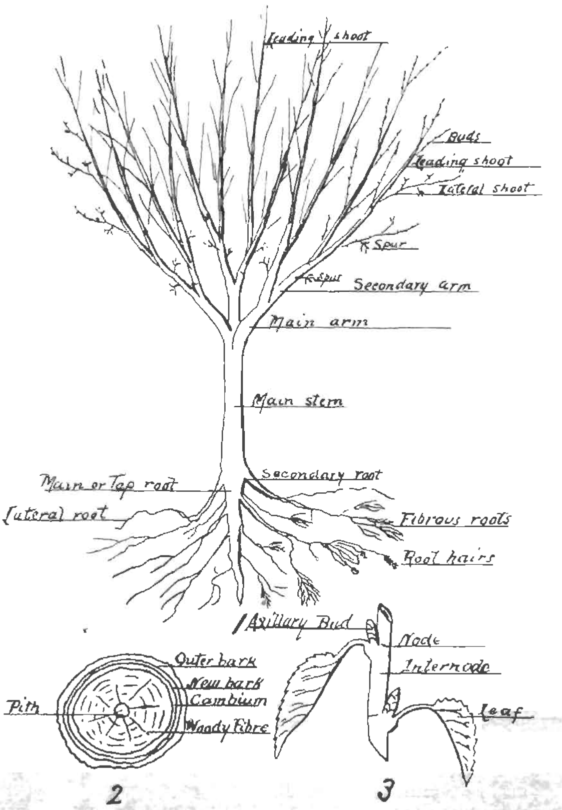
is being severed it rests in this curved hook. The handles being closed together with force, the blade descends and cuts a section through the branch parallel to the curved hook in which it rests. If the sides of the severed shoot be carefully examined, it will be seen that the edge which rested upon the hook has a margin more or less crushed. The section upon the blade side is, however, quite cleanly cut. To ensure clean sections, *the blade should always be held next to the plant*, and the hook come into contact with the severed part which falls to the ground. In Fig. 2 this operation is illustrated. Fig. 3 shows the relative positions of the bud and the parts of the secateur when severing a shoot. A swift jerky action should be avoided, as this often splits the wood or bursts the bark away from the sap layers. The pressure should be firm and continuous, so that one feels the wood give way beneath the blade.

Another kind of secateur fixed upon a pole is shown in Fig. 4. This is known as the "Standard" pruner. It consists of a pair of flattened hooks riveted together at their points. In the slot thus formed, a convex-edged blade, made of finely-tempered thin steel, is fixed. The other end of this blade is drawn out into a lever several inches long. A metal rod is attached to the lever end, and this rod passes down the side of the pole, to which it is held by staples. At the bottom of the pole the metal rod is attached to a hand lever, with which the mechanism is operated. When in use the hook is passed over the shoot to be severed, the pole is held in one hand, and the handle of the lever pulled with the other. It is claimed that the branch, being held on each side of the blade by the divided hook, is supported firmly and cut cleanly. This tool is very useful among tall trees, but it is very doubtful if in future tall trees will prove profitable. In cutting terminal shoots, however, upon full-grown trees a little bruising is not of much importance, as these growths are constantly being replaced by new ones.

FIG. 4.—
THE "STANDARD" PRUNING SECATEUR.

III.—SAWS.

At (5) Fig. 1 the curved "Improved Wingfield" pruning saw, carrying a 14in. blade, is illustrated. It is a good all-round tool, and should be kept sharp and clean, with the teeth evenly set. There are other good types of pruning saws in common use, most of which consist of narrow blades set into frames, after the manner of fretwork saws; and it is claimed for these tools that they possess advantages where it becomes necessary to use a saw in sharp angles formed by the junction of branches. Fig. 1 (6) represents an oilstone. The best for maintaining a keen edge on knife and secateur are of a rectangular shape, about 5in. or 6in. long, and about ½in. thick, known as Arkansas and Turkey slips. This type lends itself to being used in fairly sharp angular spaces. The blade of a knife should be sharpened evenly on each side, but that of the secateur upon the bevelled side of the blade only. Many other forms of these tools are extant, but those described are well-tried specimens that can be procured locally, and meet all the requirements of the average orchardist.



G. 5.—Diagrammatic Representation of the Parts of the Tree.

THE PARTS OF THE TREE.

For the purpose of simplifying in the mind of the beginner the terms used in a general sense in this book, a diagram has been prepared (see Fig. 5) showing the parts of the tree. When the seed of any kind of fruit tree germinates in the earth a portion of the young plant strikes down into the soil and forms the first root. Coincident with the downward progress of the root another portion raises itself up into the light and air. This is the original *stem or trunk*, carrying a pair of leaves, and the first root will be ultimately recognised as the *tap root*. As the stem ascends more leaves are developed, and as the terminal point continues to grow they are left stationary at fairly regular intervals along the stem. In each axil where the leafstalk is attached to this stem a *bud* is developed. The swelling or knot where the bud is located is known technically as a *node*, and the space between two buds is called an *internode* (see 3, Fig. 5). Should the growth continue uninterruptedly throughout the season most of these buds may remain dormant and obscure. If, however, the terminal bud be checked temporarily by any means, some of them will start into growth, and at once show that they possess all the potentialities of a branch. After the central terminal bud has received a check (no matter whether it be caused by some external means or the natural process of suspended growth in autumn), an increased share of sap settles about some of the lower buds. When growth again begins, these specially favored buds—usually those nearest the terminal bud—break into growth simultaneously with it The shoots arising therefrom will, if such primary shoot is checked, ultimately be known as the *main arms* of the tree. These branches will repeat in their growing season the same processes of extension, with leaf and axillary bud formation, noted in the parent or *main stem* from which they spring. The next season's development will be a repetition of that of the previous summer. The more favorably situated buds formed last year upon the main arms will break into growth and produce *secondary arms*. Another season will repeat the process, and from certain buds upon the secondary arms a third set of shoots will arise, which we will call *wood shoots or leaders*. Before this stage is reached the buds which have started into growth will have utilised, somewhat unevenly, the food supplied to them, and the differences in their progress will be fairly marked. Owing now, however, to the increasing number of buds to nourish, and their partial exclusion from an elevated position in the sunlight and air, many of those which start into growth only make comparatively weak shoots. These are chiefly those compelled to take a direction tending towards a horizontal plane. They are called *lateral shoots*.

When the buds upon the laterals start into growth they are still further restricted by unsuitability of position and lack of nourishment They are consequently transformed into short stubby growths called *spurs*. Sometimes, owing to like surroundings, certain buds formed upon lower and stouter arms thus grow directly into spurs. (The student should note that on the laterals of some kinds of trees, particularly those of the peach, nectarine, and apricot, the flower buds are directly developed during the first summer.)

If we now turn to the root we will find a somewhat similar subdivision. The original or *tap root* has continued to descend, and at irregular intervals roots of various sizes have branched out from it. These, for the sake of distinction, we will call *secondary roots*. From these another subdivision usually arises, termed *lateral roots*. From this latter section clusters of *fibrous roots* form, although—as with the spurs upon the branches—they do not necessarily arise from these small lateral roots. The brittle, sappy, terminal parts of fibrous roots represent the active food-absorbing portion of the root system, for upon their fleshy surfaces cells swell out into hair-like projections, forming what are known as *root hairs*. The work of the root hairs is to absorb moisture from the soil in which they grow. This moisture contains the various mineral salts forming the plant foods taken from the soil in solution. This crude sap passes up mainly through the sublayers of active cells of the plant into the green foliage. There, in conjunction with the gaseous constituents taken from the air, it is, in the presence of sunlight, elaborated into plant-forming materials. What is not required in the top growths is then passed downwards, mainly through the inner bark tissues (cambium), and goes to form fresh extensions of branch and root by the addition of new layers of tissue, as indicated in (2) Fig. 5.

THE DESIGN OF THE TREE.

In a state of nature every plant when allowed free scope for action takes upon itself a typical form. When man introduces a plant to cultivation he provides the protection necessary to the development of this shape, but utilises pruning to direct such a form to his best uses.

Wild grapevines climb over and entwine their stems around high trees, and many fruit-bearing plants spread in a more or less pendulous manner upon the ground, but both of these forms have to be modified as far as is in keeping with a continuance of healthy growth before these plants can be utilised to the fullest advantage by mankind. To attain this end he *prunes to modify form.*

Under certain vicissitudes of climate fruit trees are caused, by means of pruning and training, to take very many shapes, so that they may be grown under conditions far removed from those of their natural habitats. They are trained as espaliers, cordons, &c., against vertical surfaces, upon wires, or as pyramids in the open ground: but as these methods are not imperative under the favorable climatic conditions of temperate Australia I do not intend entering upon a description of them.

The modifications of the natural forms of fruit trees have been directed along certain lines until defined *types* have been recognised as suitable for certain conditions.

In the meadow orchards of England and elsewhere, where hay or grass is grown beneath the trees and animals allowed to graze, a type of tree possessing a very long stem is favored, and our early colonists naturally followed the teachings of their ancestors in training the trees planted by them here. Under the different climatic conditions and keen commercial competition now existing this type has been abandoned in the more recently planted Australian orchards.

The main object sought by the adoption of a distinct type of fruit tree in commercial orchard practice is to secure one *which will produce the greatest quantity of superior fruit at a minimum cost.* In this connection the tree which is trained to permit all the necessary operations of orchard work being conducted with the greatest facility and completeness, and at the same time maintain its productiveness over a lengthy period, is the one to adopt. On the strength of these requirements for the general conditions ruling in Australia the most widely accepted type of orchard tree is a short-stemmed, sturdy standard, of a shape varying between a broad-based wineglass and an inverted cone, accordingly as the natural tendencies of the different sorts demand. This tree offers the following advantages:—

a. The fruit may be quickly and safely harvested.

b. The pruning and treatment for diseases is easily, rapidly, and effectively performed.

c. The ground is shaded in mid-summer above the root system.

d. The soil may be cultivated without obstruction as close to the stem as is in keeping with safety.

e. It possesses the strength necessary to withstand boisterous winds.

In a previous chapter we outlined the different growths which constitute a tree. In doing so—with the exception of assuming that the leader is stopped—we followed each stage of development as it appears under purely natural conditions. Under modern economic culture, however, besides the names of parts of the tree, their relative importance

and individual bearing upon the wellbeing of the plant as a whole have to be duly acknowledged.

In the first place a full recognition of the principle of even distribution of light and air must be insisted upon. The longevity and profitableness of a tree depend upon an equal diffusion of sap being maintained to every portion throughout its lifetime. To use a popular phrase, "Natural opportunities should be equally free" to all parts of the tree alike. This ideal is most nearly achieved when all the light, air, warmth, moisture, and space for the proper spread of each branch and root is made available to it. The question of warmth, moisture, and root room has some bearing upon pruning: but the supply of light and air is of vital consideration. No sane builder starts to erect a house without first fixing upon a design to follow: likewise no orchardist should prune a young fruit tree without having a clear conception of what he requires of it, and a rational knowledge how best to attain that end.

In Rule 2 we have described that "the nearer a shoot approaches a vertical position the stronger will be its growth." This is of great importance in designing a tree. Nearly all trees tend to form a central leader which outstrips its fellows. In following such a design as is indicated at the beginning of the present chapter, this leader must not be allowed to persist. Let the reader observe any tree in which the central leader remains and he will find all side branches arising from it are forced to adopt a more or less horizontal position. The inevitable result is the extension of the leader and the formation of new side branches from time to time. These, being on a higher plane, receive more sap than those older and lower, and their presence results in the lower ones perishing or becoming devitalised. An evenly-balanced standard tree possesses *one main stem or trunk only*. From this trunk, at as near the same level as is consistent with a separate grip upon it, main branches should spring. The number is largely a matter for the pruner to decide in the presence of each variety, and of the problem presented by the growth of each individual tree. These main branches ought to originate from the trunk so as to form angles as equal as possible with it. They should be as even in strength as nature, assisted by art, can make them. When they are subdivided into secondary arms it must be done as nearly as practicable on the same level, that is, the same height from the ground. The number of secondary arms allowed to arise from each one is decided upon according to the number and strength of the various main arms. Some may have three, others two, and occasionally a simple undivided arm may be carried direct from the trunk. The direction the main arms shall take from the main stem is governed by the vigor of the variety under treatment. The natural habit of strong, erect growers, such as the peach, must be modified; consequently the mains on such require to be brought out in a direction tending to a sloping position. Weak growers should be assisted by moderately oblique directions only being given to the mains. Trees set out in rich or poor soils will have to be treated in accordance with the vigor they are expected to assume. The length of the main arms will depend upon the height the pruner wishes; but he should always bear in mind that the stem and main arms are the permanent scaffolding of the tree, and govern its future altitude. When once formed they do not lengthen, but add their increase in girth. A well-designed tree is one in which the main arms do not bend out of their proper position or split away from the trunk

when the tree carries its complement of fruit and foliage. To be sure of securing this the pruner should err upon the side of short main arms. As the main arms do not carry much small wood growth in later years, the question of the admission of light to them is not of so much moment. The length accorded to the secondary arms depends upon their stability. They must also be strong enough not to break or bend sharply when subjected to a weight of fruit and foliage, or the buffetings of storms. As they should carry laterals, the spacing of them is of importance. *They should be sufficiently wide apart to permit the proper development of the laterals which emerge between them.* As previously stated, this development can only take place in the presence of abundance of light and air. The positions of the secondary arms upon the mains are also of consequence. As the buds from which the secondary arms arise are arranged in a spiral form upon the mains, secondary arms upon strong growers may be started from side or outer buds, as the balance of the tree demands. It is rarely advisable, excepting in trees of very pendulous habits, to utilise inner buds when forming secondary arms, as the vertical position gives them an unwished-for advantage. Generally speaking, the buds selected to give rise to secondary arms should follow the line of the circumference of the tree, and not project towards the centre *(i.e.,* the stem) or across the outer margin. From the secondary arms will continue the leading shoots which carry the principal laterals upon which fruits are borne. In some trees these may be subdivided and called by other names, but the portions upon which most of the lighter fruit-bearing wood is found we call leading shoots. So far we have reviewed *the permanent parts of the tree*, viz.:—

a. The main stem or trunk.
b. The main arms.
c. The secondary arms.

Leading shoots, laterals, and spurs, according to the kind of tree, are constantly being removed or renewed, as the case demands; they constitute *the temporary parts*, viz.:—

d. Leading shoots—Classified hereunder as wood shoots or leaders.
e. Laterals—Comprising fruit shoots, fruit and leaf twigs, leaf and fruit spurs and fruit laterals.

If the frame of the tree be properly designed they may each receive their share of sap, whether they project towards the centre or circumference of the tree. These laterals should be manipulated so that the stronger ones are carried upon the stoutest part, *i.e.*, near the base of the parent shoot. *Fruiting and renewing laterals should alternate*, as this is the only method by which regular crops are assured. *This can only be obtained by regular annual prunings.* The highest achievement of the art of pruning and training is reached in the wall-grown fruit trees. By that method is secured a comparatively even distribution of the requirements of the tree. No wall space is wasted, and the tree carries no superfluous wood. It has its permanent portions carefully spread, whilst along them is distributed the lighter fruit-bearing wood. Let the pruner imagine such a methodically spaced tree curved around to a hollow-centred cup-like form, furnished with such a number of fairly erect strong limbs as the spread allotted to the tree permits, and each of these clothed all around, from bottom to top, with lateral shoots of a fruit-bearing character, and the idea thus presented may suggest more clearly the principles outlined in this chapter.

THE DEVELOPMENT OF FRUIT-BEARING WOOD.

After laying the foundation of the tree the next step is the acquirement of a knowledge of how to differentiate between flower buds and leaf buds, and to note the particular growths upon which these buds are found on different kinds of fruit trees. We will therefore seek our information first hand from Nature. We will consult the shoots themselves.

THE PEACH.

In Fig. 6 two shoots from a peach tree are shown. (I) was produced last summer. (II) is 12 months older. Let us carefully examine and compare their present differences. Starting at the base of (I) we find by reference to (II) that when it was cut from the parent shoot several small buds were left upon the stub, or portion not shown here. A glance at the base of (II) will show that they were leaf or wood buds. Following along (I) we find the buds placed in clusters, set at fairly even distances apart. If these clusters of buds are examined they will usually consist of sets of three. The outside oval-shaped ones are identical in appearance and size, but the central bud is smaller and pointed. It is usually pressed flatly against the shoot. If the examination be continued these clusters will be seen to cease near the top, and give way to isolated specimens of the flat pointed buds marked W. The shoot finally terminates at (1) in a leaf bud. If similar shoots be watched as spring time approaches, the outside buds F will swell up and expand into flowers. The small flat pointed buds W will extend out of their brown scaly covers and develop into shoots. Some, however, of each kind perish. While some of the small ones (leaf buds) apparently remain dormant during the summer, such a privilege is not accorded their larger companions. They must carry flowers and set fruits or at once pass out of existence; hence *the age of the shoot is indicated by the buds found upon it.*

A glance at (II) shows how the different buds behaved upon it during last summer. The leaf buds at its base marked W remained dormant. The short spur-like growths marked F S represent the development of the small flat leaf buds which were located in the clusters. At the base of each of these an old dry projection can be seen. This is the dried up fruit stalk, showing in each instance where a peach matured. This fruit arose from one of the flower buds which accompanied the flat leaf bud that is now represented by one of these short spur-like shoots. Its companion flower bud, however, perished. The bud formation on the topmost shoots marked 2 and 3 is similar in every respect to the growth on (I). No doubt last winter (II) terminated in a leaf bud, as (I) does now, but the pruner cut it away at X, and two of the isolated leaf buds took up the running. For the reason why these two shoots did not grow evenly, but grew more strongly than those below them, marked F S, the student can safely refer to rule 6 in the chapter on theoretical principles, page 4.

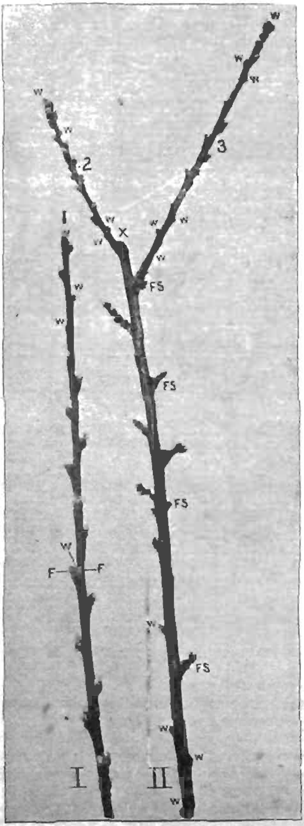


FIG. 6.—THE PEACH.

THE APRICOT.

On Fig. 7 five shoots cut from an apricot tree are depicted. (I) is a typical shoot made last summer. At its base the presence of undeveloped buds is indicated by scars only. Along it clusters of buds in threes are seen. These consist usually of two outer dark-brown buds, between which a much smaller grey-looking bud is noticed (compare with the bud formation on the peach shoots). Near the summit of the shoot

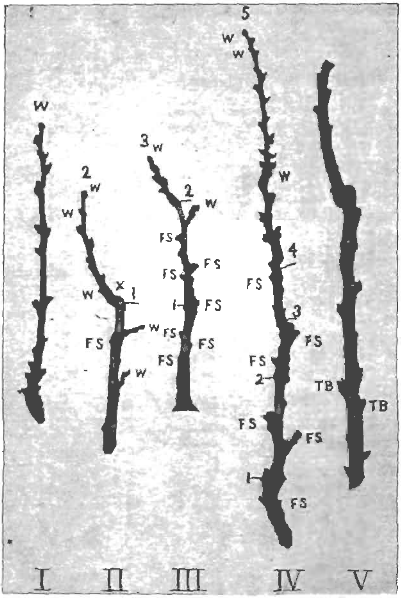


FIG. 7.—THE APRICOT.

several isolated small grey buds are noted. The shoot ends at W in a single bud of this kind fixed in a side position, akin to a bayonet upon a rifle. (II) tells us what mission these different buds perform as the year advances. It represents a shoot with two seasons' growth upon it. It was pruned off at X last winter. In spring the side buds in the clusters expanded as blooms, and set fruits, F S, at the base of the short twigs marked W. These arose from central grey buds, *consequently the side buds in each cluster were bloom buds, and the central one a leaf or wood*

bud. The bud formation on the top growth above X is identical with that on (I), consequently this branch, though weaker, must be of the same age. (III) represents a spur with three seasons' growth upon it. Three summers ago it grew from the base to 1, and terminated in a leaf bud. Not being pruned in the winter following, this leaf bud continued the growth to 2 during the next summer. It also bore several fruits, shown by the little scars F S. The point of the shoot being damaged, two leaf buds started simultaneously, and the topmost extended to 3, where it ended in a leaf bud, as usual. At the same time fruits were carried at the small scars F S, between 1 and 2, but none between 1 and the base. The flower buds on this space having performed their work during the previous summer are not replaced, and no more fruit will be carried between the base and 1. (IV) is a spur with the growths of five seasons upon it. The figures indicate each successive lengthening, and the student can work out the details. He will notice during the last season two growths were added, from 4 to W, and thence to 5. This occurs when the ripened shoot again starts into growth, owing to a summer rain or irrigation. Careful examination will show that the terminal addition to each of these has a bud formation and general appearance similar to that of (I). The discoloration of the bark, combined with the decaying fruit scars, all indicate the age of each section of growth in the past. (V) is a piece of a leading shoot cut from an apricot tree. Its bud formation declares it to be one season old. If a similar shoot were observed during the spring it would be found that although the side buds in the clusters, which contain from three to six buds, sometimes opened into blooms, they seldom carried fruits. The middle buds may, however, make strong wood growth. It will thus be seen that the apricot fruits upon shoots one season old—that is, shoots formed during the previous summer. These, if left unpruned, lengthen terminally from year to year.

THE EUROPEAN PLUM

In Fig. 8 various growths from a plum tree are depicted. (I) is a lateral shoot carrying the growth of three seasons. Three summers ago it grew from its base to 1, and formed a leaf bud on each node upon its length, and terminated in a leaf bud. The following season it lengthened from 1 to 2, and the axillary leaf buds, between the base and 1, formed up into plump little stubs, each surmounted by several flower buds. Between 1 and 2 axillary buds were again formed. Next summer the terminal bud grew on to 3, forming the usual axillary leaf buds, W, along its entire length from 2. Four of the buds of this character, formed during the previous year, grew out at the same time into short stubs, marked S P. At the same time flowers expanded and fruits formed between the base and 1, at fruit scars indicated by F S. If we analyse this growth we can tell the character of the buds formed. As stated previously, flower buds do not adhere longer than one winter in a dormant state, but when formed must develop into blooms during the following spring, and pass away or fall unopened. Now, the student should compare this with the apricot shoot; he would find that if this were on an apricot tree, while it lengthened from 1 to 2 fruits would be carried between the base and 1. We find, however, that only when the section from 2 to 3 is being formed during the third

summer that fruits set between the base and I. This leads us to the conclusion that the ordinary wood upon the European plum does not carry fruit until it is two seasons old. As the growth shown in (I) has not been pruned we can detect the fact that each season's extension ends in

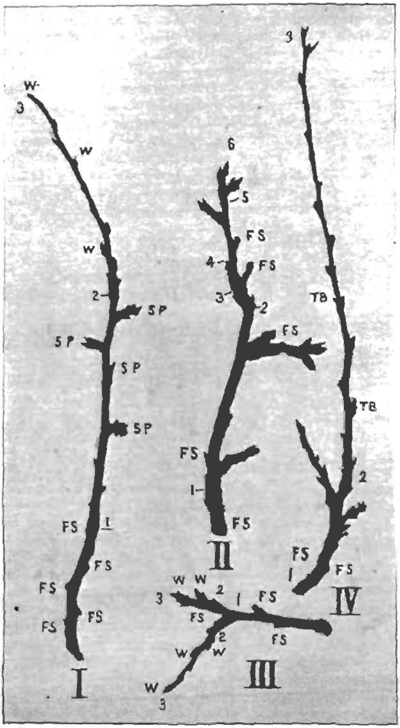


FIG. 8.—THE PLUM.

a leaf bud. On (I) all of the buds made upon the terminal growth during the last summer are leaf or growing buds. This is not always the case, however, as a glance at (IV) will reveal clusters of three buds, T B, somewhat akin to those noted on the apricot. These, however, rarely persist

to a fruit-setting stage, excepting upon trees of a mature age, and in this their behaviour very closely resembles that of buds found on wood of a similar age upon the almond. (II) carries the growths of six seasons, as indicated by the figures. The ages of the growth seen upon its laterals are naturally one year less than the portions of the original shoot from which they spring. The remaining letters and figures indicate the same particulars as explained in (I). (III) is the growth of a short branching spur three summers old, and (IV) of a more vigorous one of a similar age, as its base at 1 is the end of the first season's development, and not the beginning The triple clusters of buds, T B, previously mentioned, are seen, and if similar buds are observed in the spring the central one, which is a leaf bud, will always take precedence. It is usually distinguishable in winter by reason of its larger size compared with its accompanying flower buds. (Note the difference in this respect with those of peach and apricot.)

THE JAPANESE AND AMERICAN HYBRID PLUMS,

Besides possessing the spur-forming habit of the varieties of European origin, also bear upon fruit shoots identical in bud arrangement with those found upon the peach and apricot (see 2, Fig. 48). In this they more closely approach the fruiting habit of the almond.

THE CHERRY.

Fig. 9 illustrates a spur (I), and a lateral (II), cut from a sweet cherry. If an annual shoot of a cherry tree be examined the bud formation will be found to consist of a single bud placed in the axil of each leaf, and a similar bud at the apex. As the spring approaches such buds do not burst into bloom, consequently they cannot be flower buds. If we turn to (I) a number of concentric rings of irregular scars are seen upon it, marked by lines. Above, on the right and left, we see two small crowns of buds marked F W F. A year ago these were each represented by a single plump bud, and while the top of the spur grew from 6 to 7 the buds gave rise to these little crowns. They consist of several bloom buds, F, with a wood or leaf bud, W, in the centre. In the spring these burst into flowers and leaves respectively. Owing to its poor opportunities the bud, as a rule, only shows itself as a cluster of leaves. When the cherries are picked in the summer this little stub is frequently plucked away entirely, and all that is left to mark the spot is the ring of scars referred to above. This operation is represented on (I) by five lines, each showing a season's work. The spur is topped by a leaf bud at W, consequently its extension is terminal. This process is repeated in (II), which is four years old. Near its base a central leaf bud has survived the fruiting stage and dried to form itself into a separate spur, but its

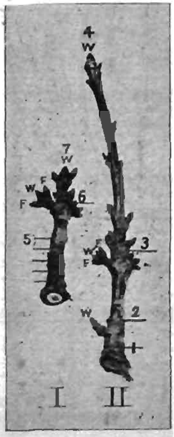


Fig. 9—The Cherry.

efforts would doubtless have ended in weakness and death. The possibilities before every spur which ends in a leaf bud are seen in this illustration. After carrying fruits for two seasons a change came over the fortunes of this humble shoot, owing probably to the removal of portion of the leading shoot above it. The growth from 3 to 4 indicates its improved prospects. (Consult rule 6 in theoretical principles for the explanation.)

THE ALMOND.

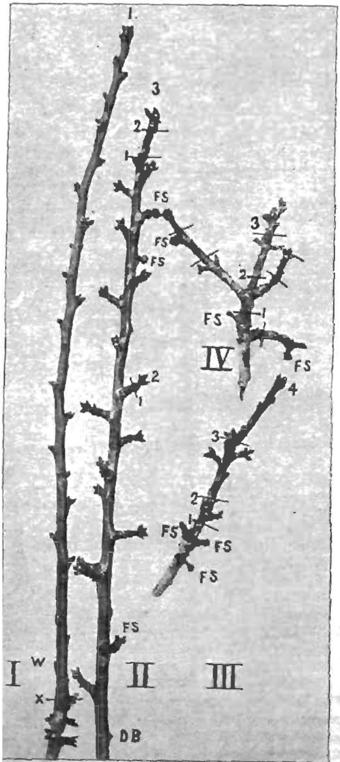


Fig. 10.—The Almond.

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Fig. 10 deals with four typical shoots from an almond tree. (I) is a shoot of last season's production from X to the summit. At its base, W, small flat-pointed buds are placed singly. Following up we see clusters of three or four buds, and at its apex 1 a cluster of buds almost on the same level. (Compare with the peach.) In these clusters small sharp-pointed buds are noted, but they point away from the shoot at the same angle as the others. In spring these would develop leaves and form small shoots or spurs, while the others expanded into blooms. Thus far the resemblance to the peach is very close. Two years ago (II) was precisely similar to (I), so let us trace its development since then. If we look for fruit scars we find them on small stubs, F S, but not immediately upon the main shoot. This clearly indicates that the flower buds formed in the original clusters did not give rise to fruits. The leaf buds which accompanied them, however, grew out and formed short spurs each of which ended in another leaf bud surrounded by flower buds. The main shoot in the same season extended from 1 to 2, and terminated its growth in a similar manner. The next summer saw a few fruits borne on these spurs, and the parent shoot grew from 2 to 3. The following season would have most likely produced a good many almonds upon these spurs. It will also be noticed that the small buds, D B, at the base remained dormant. (III) is a spur which has gradually extended in the manner described, and (IV) shows an old branching spur, and the reader is left from the letters and numerals to work out the details. The fruiting habit of the almond is often compared with that of the peach, but these illustrations show that, although the arrangement of the flower buds of the two are practically identical, in the setting and maturing of its fruits the almond more closely coincides with the habits of the plum. From the clusters of buds on the annual shoots of the peach the fruits often persist, to the discomfiture of their accompanying leaf buds. This is frequently reversed in the almond. Owing to the death of many leaf buds when the spur assumes a much branched habit (see IV), the necessity for maintaining a regular supply of young spurs will be appreciated. This can be best met by stimulating the growth of a number of shoots like (I) during each season.

THE PEAR.

An annual shoot and a six year old spur cut from a pear tree are shown in Fig. 11. If we trace the bud arrangement upon (I) we will see a number of sharp-pointed buds, W, arranged singly, and as the top is approached they increase in size. The shoot ends in several buds associated almost—though not quite—on the same level. When the summer approached the sharp buds on the lower portion would either remain dormant or develop leaves and lengthen out into little spike-like spurs, such as is seen at W on the lowest branch of (II). Several of the larger buds, F, near the top may break into bloom, but could not be depended upon to carry fruits. The cluster of buds near the top will make shoots and form that unsightly and unsafe crotch of three shoots so frequently seen upon pear and apple trees when the leaders are left untopped. (II) shows a different system of spur extension to any of the sorts examined previously. Starting from its parent branch it grew out as a short stub during the first year to where 1 is seen. Continuing the next summer it grew to 2, and formed a

flower bud. Like most first blooms on the pear, these failed to set, and left a scar, marked B. The student will notice that this flower bud was on the apex of the spur. Immediately below the flower, however, several leaf buds are located. Two of these started simultaneously. The upper one, as usual, took the larger share of sap, and formed another flower bud at its apex. The lower one only extended to where the first line crosses it, and it ended in a leaf bud. Next summer a pear, F S, arose from the flower bud on the strong section. Three base buds started to grow while this pear was developing, but the lowest ended in a pointed leaf spur only. The other two reached 3 and F S respectively. In the meantime the lowest branch of all grew to where the second line is drawn across it, where its point met with some accident. Next summer the upper division carried a pear at F S, and three base buds grew to 4 respectively. Its less vertical companion on the left-hand side extended from 3 to 4. The next season saw them with lessened vigor lengthen from 4 to 5. On each division at B a flower cluster opened and fell, and at F flower buds were formed. The lowest branch advanced but little, still, should the pruner desire to shorten back the now weakening and ramifying spur he would find this member useful on account of its close proximity to the main source of sap supply. *A careful study of this spur teaches us that on its branches a fairly regular system of alternative development of fruit and leaf buds is maintained.* The more favorably-situated bud from year to year, by receiving the most nourishment in the way of elaborated sap in the summer, forms the flower bud for the coming season's fruit.

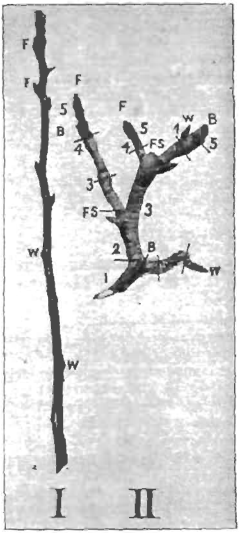


FIG. 11.—THE PEAR.

THE APPLE.

Fig. 12 shows three shoots cut from an apple tree. (I) is an annual shoot, and its bud arrangement shows a series of single buds, W, along the whole distance until the top is reached. Here three buds, marked W, are located closely together. Next summer the single buds would either remain dormant or grow out into short twigs and leaf spurs, and the group at the top would start together. As in the pear, an awkward crotch is formed, and possibly the desired direction of the growth lost if these are permitted to continue. No flowers open, so we

conclude they are not generally formed upon strong annual shoots of the apple. (II) represents a shoot several years old. Two seasons ago it carried a bud system similar to (I). The lower buds, marked F, then grew out into short leaf spurs, while at F S a flower bud was developed.

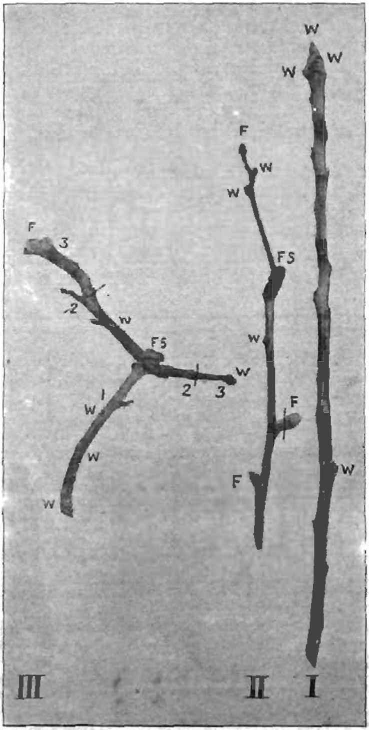


FIG. 12.—THE APPLE.

Last summer the lower spurs lengthened slightly and formed flower buds at F. The top of F S carried a bunch of blossoms and sent out a side basal shoot to F, where a flower bud is seen. Two leaf buds, W,

were also formed. The shoot drawn in (II) is a lateral taken from a part of the tree not favorably situated for receiving much sap, hence the tendency of the buds to attempt the formation of flower buds freely. (III) is a spur from the much-prized Cleopatra apple. The growth from the base to F S is the work of two seasons. At F S a fruit grew during the summer following, and the usual side or lateral divisions started. These extended to 2 respectively. The point of the left-hand shoot died back, and that of the right-hand side set a weakly flower bud. Next summer this fell infertile, and the shoot extended to 3, ending in a leaf bud. Meanwhile the left hand shoot lengthened, and its point being injured, two side buds swelled into flower buds at F. These examples show that in the development of the fruiting wood *the apple and pear are practically identical.*

THE QUINCE.

Fig. 13 illustrates two growths taken from a very productive quince tree. The right-hand shoot is a typical annual growth, found in every quince tree which has been severely pruned the previous season. It has single buds placed all along its entire length, and terminates in an isolated bud. Next summer some of these would break into growth and make thin wiry shoots, while the terminal point would extend. From a rank shoot of this character no fruit would be assured for an indefinite number of seasons. If it be a water shoot—that is, coming from wood many years old —fruits may never be carried upon it. The left-hand shoot is the ordinary fruit-bearing growth of the quince tree. It was cut from older wood, so the figures refer to the growth upon this particular portion only. The first year it reached beyond 1, and, as is peculiar to the quince, the point died back. Next year two side buds started and grew to F respectively. They bloomed simultaneously there, but bore no fruit. The vertical division sent out two shoots each to 3, and the lower one lengthened likewise. Next spring the lower portion of the left hand or vertical division subdivided again to Q. Its companion progressed likewise to F B. The lower right-hand spur also advanced to Q, where a fruit matured, and two small stubs only emerged at S T. The stronger half of the other subdivisions immediately above gave rise to S T, and its weaker half grew to F B, where double buds probably indicate bloom next spring. The left-hand erect growth did likewise at F B, and its weaker companion only extended in a trifling thin shoot. In this we see a somewhat close resemblance to the alternate fruiting of the pear and apple, and the same lateral extension of spur-like growths beneath the fruits, which are borne terminally. The sturdy branchlet always carries the fruit for the year in which it is more robust. The buds which produce the flower stalks are usually formed singly, almost on the same level as an accompanying leaf bud. This gives the pair a somewhat clubbed appearance. The flowers themselves are borne singly and terminally upon a short leafy stem which grows out immediately before the blossom opens. In this they resemble the apple and pear, and differ from stone fruits.

One fundamental difference between the positions occupied by the flower buds of the pip and stone fruit trees respectively is that those of the former are terminal, while those of the latter are set laterally upon the shoots which carry them.

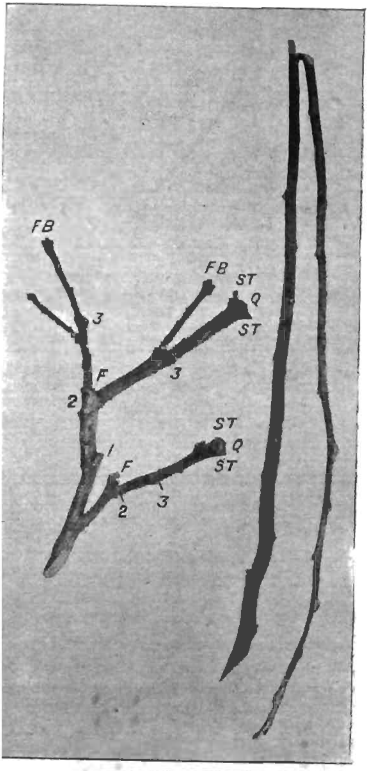


Fig. 13.—The Quince.

A CLASSIFICATION OF THE SHOOTS OF DECIDUOUS FRUIT TREES.

Although not founded on a strictly scientific basis, it is hoped that the definitions given below will prove sufficiently clear for the guidance of the student of fruit-tree pruning. They represent an attempt to overcome a difficulty which sooner or later forces itself upon every person who desires to impart to others the facts he has observed in respect to the practice of this art. It is not sufficient for the teacher to constantly refer to "shoots" and "spurs" of a very diversified nature, appearance, and value, without being in a position to apply to each some distinguishing term which is founded upon a prominent and constant characteristic peculiar to that growth.

The shoots demanding the attention of the pruner are herein classified under the following denominations :—

a. The wood shoot or leader.
b. The fruit shoot.
c. The fruit twig.
d. The leaf twig.
e. The fruit lateral.
f. The leaf spur
g. The fruit spur.

THE WOOD SHOOT OR LEADER is the strongest annual growth, and arises from the higher portion of the leader of the previous year, or, if it proceeds as a so-called "water shoot," from a less elevated position on the framework of the tree it is because an abundance of sap was directed into it by some accident or design. On such trees as the peach, nectarine, apricot, almond, Japanese and American hybrid plums, which form flower buds on annual wood, its primary bud formation consists of one leaf and one or more flower buds at each node. Occasionally flower buds form on the wood shoot of the pear and apple, but to a very much lessened extent. The flower buds may be present at any node on the other trees, but the leaf bud is always there. The flower buds are rarely of any value for fruit bearing, but any leaf bud can be relied upon to yield strong growth providing the ascending sap be forced into it. The general use of the wood shoot is to extend or renew the framework of the tree.

THE FRUIT SHOOT.—This, owing to its lower and more lateral position, receives less sap, and consequently it is a weakened modification of the wood shoot. It is found only upon those trees such as the peach, nectarine, apricot, almond, American and Japanese hybrid plums which form their flower buds upon the current summer's growth. Its bud arrangement consists of several leaf buds at the base, with similar buds placed, either alone or accompanied by flower buds, at numerous joints scattered throughout the length of the shoot. It also terminates in a leaf bud. It is especially valued for fruit bearing, or giving rise to other fruit-bearing shoots.

THE FRUIT TWIG.—This is a weakened form of the previous shoot, due also to its inferior position upon the tree. Its bud formation consists of leaf buds at the base, with a succession of single flower buds or

an absence of any buds whatever, until the terminal point is reached. Here one or two leaf buds, either alone or accompanied by a cluster of flower buds, are formed. This twig is found upon the peach, apricot, nectarine, almond, American and Japanese hybrid plums. It is valued for fruit production or refurnishing new fruiting wood, either by the extension of its tip or from the buds at its base.

THE LEAF TWIG.—This is usually a slender, weakly, or pendulous shoot found in any lateral position upon the peach, nectarine, apple, pear, all kinds of plums, cherry, and apricot. Its bud furnishing is comprised of leaf buds only from base to apex. Excepting on the two first-named trees, it is valued, when suitably placed, for the early production of spurs from these buds, and its retention checks the vigorous ascension of the tree in general.

FRUIT LATERAL.—This is a very similar shoot to the leaf twig, excepting that a flower bud crowns its terminal point, whilst usually, but not invariably, its other buds are leaf-forming. It is found on the apple and pear only, and is valued because of its potentialities for the immediate production of fruit, as well as for giving rise to fruit spurs and checking the excessive formation of wood shoots.

THE LEAF SPUR.—This is a short growth representing one or more season's extension from a leaf bud. It is a weakened leaf twig in miniature. It may arise from a bud situated upon any part of the tree, but is most frequently found on other lateral shoots, such as the leaf twig and fruit lateral. Its bud complement consists of a pair of imperfectly developed base buds and a terminal leaf bud, the intervening space merely carrying the scars of the leaf stalks. It is found upon the apple, pear, plum, cherry, almond, peach, nectarine, and apricot. It is valued as the preliminary stage in the development of the fruit spur, and is rarely dealt with in an individual sense by the pruner.

THE FRUIT SPUR.—This is usually the culminating condition attained by the leaf spur, and is a short-stemmed growth with various scars upon its stem portion, indicating where leaves or fruits have been borne. On stone fruits, such as the peach, nectarine, apricot, almond, plum, and cherry, its buds consist of a cluster of flower buds surrounding a central leaf bud at the terminal point; on the pear and apple its only observable bud in winter is a more or less globose flower bud at the apex. It is valued for fruit production and, with the exceptions of the peach, apricot, and nectarine, it is almost the sole form of reliable bearing wood upon the kinds mentioned.

TABLE SHOWING CLASSIFICATION OF SHOOTS.

Wood Shoot or Leader.	Fruit Shoot.	Fruit Twig.	Leaf Twig.	Fruit Lateral.	Leaf Spur.	Fruit Spur.
All kinds of Fruit Trees	Peach Apricot Nectarine Almond Japanese and American Plums	Peach Nectarine Apricot Almond	Peach Nectarine Plums of all kinds Apple Pear Cherry Apricot Almond	Apple Pear	Apple Pear Plum Cherry Almond Peach Nectarine Apricot	Apple Pear Plum Cherry Almond Peach Nectarine Apricot

PRUNING TO AVOID DECAY.

The early acquirement of a knowledge of this phase of the subject is of primary value to the pruner, as it may mean much to the wellbeing of his orchard trees. The full importance of this can scarcely be appreciated until the pruner has obtained an intelligent grasp of how a tree is built up by the addition from year to year of successive layers of cells.

It may be argued that if a tree is trained correctly from the outset the amputation of large limbs will be unnecessary as it attains more mature years. This contains much truth; but accidents, or the need to refurnish the lower limbs with fruiting wood, or renovate by grafting, often render such operations imperative.

If the pruner pursues faulty methods in making sections, whether with knife, secateur, or saw, be they upon large or small branches, evil results must follow sooner or later.

Pruning of any kind causes a wound, and, other things being equal, it is in accordance with the age and development of the part affected that the period of healing is hastened or delayed. For instance, the young sappy point of a shoot pinched out ere it gets beyond the composition of cellular tissue, is healed over in a little while, leaving only a brief trace of the injury. A large branch a foot or more in diameter, when severed, may never be able to heal over the cut section.

If a newly-cut transverse section of a large limb of any fruit tree is examined, it will be readily noted that it has been built up by a succession of concentric rings of growth, each added *externally* year by year. The rings in the centre are harder, and compressed into extremely stiff woody fibre, possessing apparently little vitality. As the examination proceeds towards the outer margin the wood becomes more sappy, and as the edge is reached it ends in contact with the corky substance we call bark. If an incision through the bark is made during the period of active growth it will be noted that immediately beneath it a sappy viscous layer of tissue is being formed. This is known as the cambium layer, and it represents the portion of the stem which is actually growing, and which will form, as it ripens in autumn, the last concentric layer referred to before. The inner layers of woody fibre have not perceptibly grown since ceasing to be of this nature, although they appear to retain a low degree of vitality as long as protected from outward contamination. This explains at once why the small sappy shoot heals more rapidly than the large woody limb. In the first case the whole of the wound was made in the annual growing layers; in the second the cambium layer must grow from the outer edges—immediately beneath the bark—until they converge and cover the whole of the wounded surface. In (2) Fig. 19 this healing process is depicted as it takes place around a large wound under favorable conditions.

The annual addition of this layer of growth, built up as it is on the *outer* surface of that made during the previous season, increases the diameter of the branch, and bursts the dryer bark, giving rise to the cracked scaling bark, well known as a refuge for certain orchard pests.

To repeat, a rapid healing of the wound is necessary to avoid decay. A wound coming directly under the influence of the sap as it flows freely into buds or shoots which are making active growth will, therefore, be

healed up in the shortest time. This is why the pruner is advised to shorten back a useless or unfruitful limb to where a healthy shoot arises from it, and not to a blind budless stump which possesses no means of drawing sap to heal itself.

In Fig. 14 at A, the position of the section to the bud is one which practice has proved highly favorable to the speedy healing over of the wound. It will be noted that it begins about on a level with the base

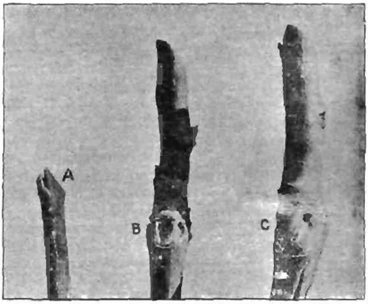


FIG. 14.—SHOWING (A) DESIRABLE POSITION FOR SECTION, (B) AND (C) SUBSEQUENT RAPID HEALING OF THE WOUNDS.

of the bud, and directly opposite to it, and slopes obliquely off just over the apex of the bud. At B the healing of the wound a season later may be seen, and at C the healing process is almost completed during the next summer. This rule is departed from in practice under certain conditions, for instance, when it is desirable for the new shoot to turn away at a broader angle, and, again, on trees such as the apricot, the bark of which bruises and decays very readily. In these cases a longer piece of internode is retained, temporarily, above the topmost bud.

At A in Fig. 15 is a section made in a manner liable to prevent an early healing of the wound, and to give every opportunity for permanent injury being sustained by the branch. The blind stub has already died down half its length, but if cut as indicated at B on same plate the injury would be arrested and proper healing ensured. C shows how decay gradually creeps down a dying stump until it reaches a point lower than where the sap passes into the shoot immediately below it. This shoot would have drawn up sap to heal it over had the section been made as seen at B; but now the descending decay will injure the branch to such an extent that it may split off, or be outgrown by another immediately below the decayed portion. This, in a young tree, may destroy its symmetry.

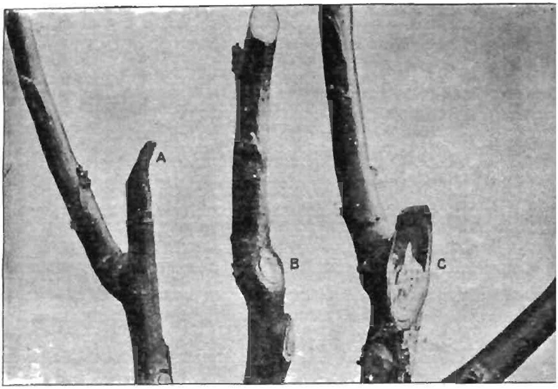


FIG. 15.—IMPROPER SECTIONS.

(A) CUT TOO FAR ABOVE THE BUD. (B) HOW TO REMEDY THE DEFECT (C) EVIL RESULTS OF NEGLECTING (B).

At A in Fig. 16 a section is shown in which the pruner has gone to another extreme, and cut too far below the bud intended to give rise to a leader. This wound could not heal rapidly because the bud must be

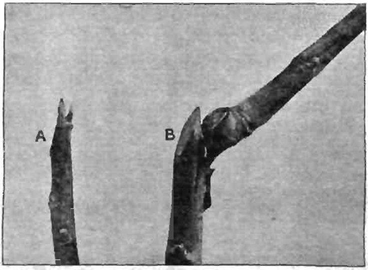


FIG. 16.

(A) A SECTION BEGUN TOO FAR BELOW THE BUD WEAKENS THE SHOOT ARISING THEREFROM.

(B) A POSSIBLE RESULT.

half starved, resulting in a lower bud gaining the ascendancy, and probably upsetting the balance of the top. There is also much danger of the splitting shown in B eventuating in after years.

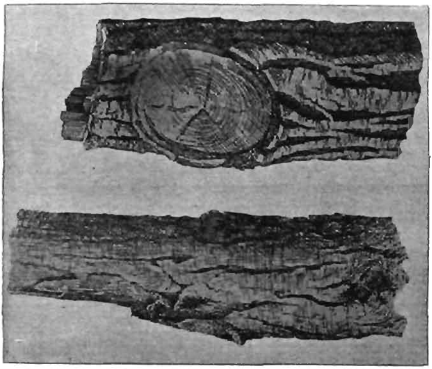


FIG. 18.
PROPER POSITION FOR A LARGE WOUND—SIDE AND FRONT VIEWS.
(AFTER L. H. BAILEY.)

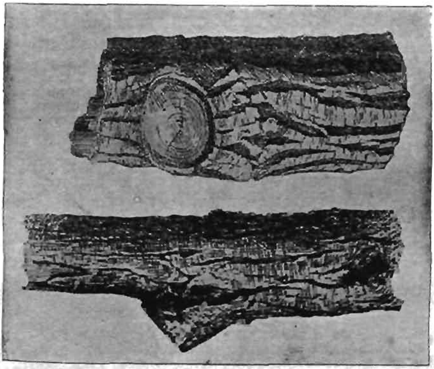


FIG. 17.
THE WRONG POSITION FOR A LARGE WOUND—SIDE AND FRONT VIEWS.
(AFTER L. H. BAILEY.)

In Fig. 17 the side and front views of a wrongly-placed section made in severing a large limb is illustrated, and similar views of a rightly-made section are shown at Fig. 18.

In Fig. 19 the wrong and the right methods of cutting off a large limb are depicted. The results speak for themselves. The dead stump will prevent the wound healing over, and gradually the decay will sink into the

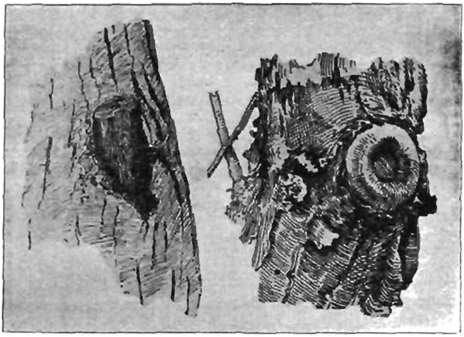


FIG. 19.

LEFT-HAND LIMB IMPROPERLY CUT. RIGHT-HAND LIMB PROPERLY CUT.

(AFTER L. H. BAILEY.)

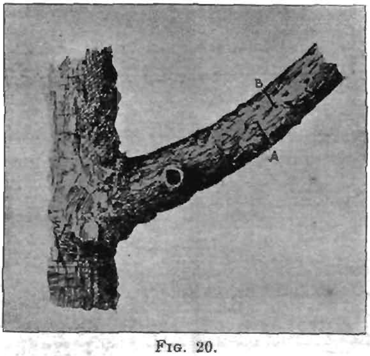


FIG. 20.

TO PREVENT A WOUND SPLITTING, CUT FIRST AT A, SECONDLY AT B.

(AFTER L. H. BAILEY.)

heart of the stem, and when the dead stub falls out a knot hole leading into a hollow trunk—so common in gum trees (Eucalypts)—will result.

Fig. 20 indicates the correct method of making a cut to remove a large limb. The section should, however, be made close to the junction of the limb with the stem: but the plate is meant to show how simply the splitting down of the wood and tearing of the bark may be avoided. First a saw cut is made at A, on the under side, then the upper side is sawn through at B. After the limb is removed a second cut is required directly over A to rid it of the projecting end and to thus facilitate the healing process.

The utmost consideration in the study of the healing of wounds must be given to their positions upon the tree, and the manner in which they are made. In the case of a large wound, however, the healing of which under favorable conditions may occupy many years, there are other causes of failure to be taken into account.

Although not strictly connected with the operation of pruning, the after treatment of large slowly-healing wounds is of sufficient importance to warrant the inclusion here of a short digression upon the subject. As we have noted above, the central woody layers which form the main body of the trunk or limb are practically inactive, though protection from outer influences apparently retains vitality within them. When a section is made through one of these this non-growing portion is exposed to the action of the elements, and organised bodies soon start to reduce the complex stem back to the more simple chemical elements from which it has been built up by the vegetative functions possessed by the parent tree. As soon as the surface of this inner wood is exposed it loses moisture if the sun is powerful, or absorbs moisture if the atmosphere is thus charged; in other words, it begins to dry out or absorb moisture, just as the prevailing weather determines. This process gives rise to oxidation, or, as the gardener would term it, "dry rot." Very soon spores of bacteria and saprophytic fungi find a lodgment, and enter upon the work of changing the nature of the wood. Eventually wood-burrowing grubs, caterpillars, and ants find an entrance; and soon larger animals such as, in the case of our gum trees, birds and opossums, complete the destruction by hollowing out habitations for themselves. This is, in short, a process of nature whereby the weakly and unfortunate members of the vegetable kingdom are condemned.

The object of the pruner is to avoid this by circumventing these prominent factors of decay. To attain this end—

a. He prunes at the proper season.

b. Makes the section in a sloping direction, to escape excessive moisture or heat (see Fig. 18).

c. Makes clean smooth cuts, without bruising the margin.

d. Dresses the wound with a compound calculated to prevent the entry of elements of decay.

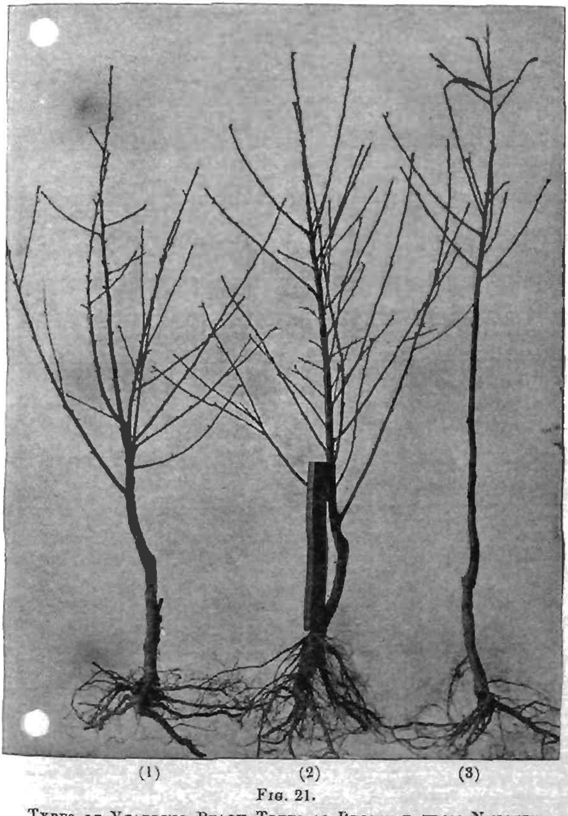
For all purposes knife, secateur, or saw should be kept as sharp as possible. Immediately a large wound is made it should be cleaned of sawdust or dirt, and dressed. If this is done the condition of the weather at the time is of little consequence. If no dressing is used, wet cold weather should be avoided in making large wounds. Cleaning the edge of a saw wound with a sharp knife is not always necessary if the saw is sharp and the pruner careful to avoid separating the bark from the sap wood around the cut section.

Many kinds of dressings have been used and tested, but two, which may be readily obtained and easily applied are common oil lead paint (old rejected stuff will do) and tar. Of these preference should be given to the paint, as tar is—when exposed to the sun—likely to burn the healing callus. These dressings have the advantage of retaining a closer hold upon the wound than any form of wax, shellac, &c., and do not peel away after a season or so. They are also antiseptic—a quality not possessed by the others. It should be clearly understood that none of these dressings are healing in their nature, but simply ward off decay until the wound in the tree is healed over by the growth of its own tissues.

Fruitgrowers who have to contend with fungus diseases, and practise spraying with Bordeaux mixture, would act wisely by spraying with this fungicide immediately after pruning, so that the wounded sections might be coated with the mixture, as it possesses antiseptic properties.

PART II.

PRACTICE OF PRUNING DECIDUOUS FRUIT TREES.

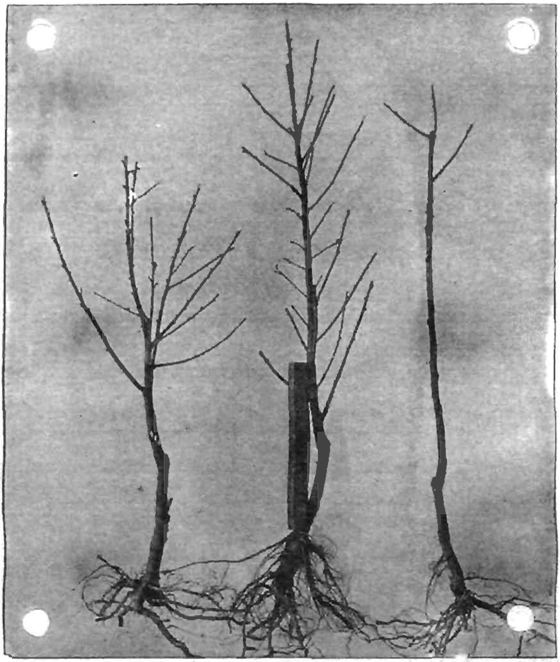


(1) (2) (3)

FIG. 21.

TYPES OF YEARLING PEACH TREES AS RECEIVED FROM NURSERY.

As there is some peculiarity of form about every young tree which may perplex the beginner, we will therefore proceed to follow, through its varying stages, the development of trees of this type designed from the materials at hand.



(1) (2) (3)

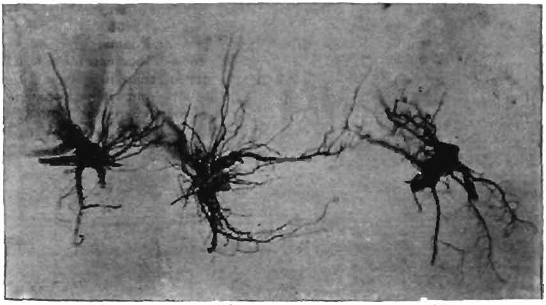
FIG. 22.

SOMETIMES YOUNG PEACH TREES ARE PRUNED THUS.

In Fig. 21 may be seen three fair types of young peach trees, as received from the nursery. (1) Was topped as it grew in the nursery row, consequently it developed several shoots of varying strength from the main stem. (2) Received some check in its growth, probably owing to a slight dryness at the roots. This stunted its central leader, and when

active vegetation began afresh later in the summer some of the lower buds forged ahead for a time, and produced about half a dozen shoots. If this tree be examined, nature's pruning will be seen in the partial suppression of several shoots in the middle of the stem. (3) Grew in a dense bed of young trees, and, partly as a consequence of overcrowding, the lower buds have not had a chance to develop into shoots, and only a small portion have grown at the top.

Fig. 22 shows how such trees are often pruned, and later on reference will be made to the resulting consequences.



(1) (2) (3)

FIG. 23.

THE ROOT SYSTEMS OF TREES IN FIG. 21.

Fig. 23 is a photograph of the root system of these three trees taken from beneath. The main roots are pretty well all broken at their extremities, and, owing to being exposed to the air, the fibrous roots are nearly all dried up and dead

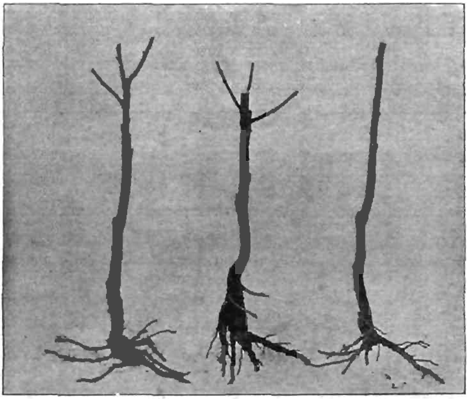
Fig. 24 shows these root systems in the same order, trimmed carefully of all interlocked roots, broken points, and dead fibres, ready for planting. It will be noticed that nearly all roots smaller in diameter than an ordinary writing pencil have been cut away, and the larger roots shortened considerably. The ordinary nursery methods of packing young fruit trees

(1) (2) (3)

FIG. 24.

THE SAME ROOT SYSTEMS PRUNED BEFORE PLANTING.

do not preserve the more tender roots. This is not such a calamity as it may at first appear, as, when consideration is given to the manner in which the stem and branches are so greatly reduced, it will be readily seen that a balance may be regained. If a tree, the shrivelled roots of which have not been pruned at planting, be dug up in twelve months' time and examined, scarcely any new extensions will be found to have issued from the smaller ones, just in the same manner as when the top of a young tree is left unpruned on being planted many of the partly-matured terminal twigs will die, and fresh ones emerge from the more solid wood below. Whether it is owing to immaturity they are incapable of emitting other roots is difficult to determine, but most probably the reason why so many perish is because of the exposure and damage received in transplanting. The time spent in trimming these roots carefully would be more than counterbalanced by the saving of time in planting the trees. The too common error of coiling the long entwined horizontal roots to compel them to enter the hole opened for their reception, instead of making the hole to accommodate the irregular roots, would also be largely avoided.



(1) (2) (3)

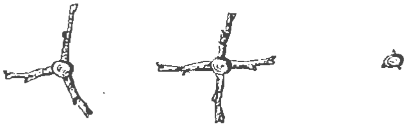
FIG. 25.—PEACH TREES IN FIG. 21 CORRECTLY PRUNED.

In Fig. 25 an endeavor is made to show how these three young trees should be top pruned to obtain the shape herein suggested as suitable to our conditions. For the purpose of connecting all the points in the working out of our design it will be necessary to refer the reader to a number of statements relative to the first steps in the formation of the tree as set out on pages 16 and 17.

A glance at Fig. 21 will show the much more uniform growth in the branches sent out by (1), where they start on almost the same level, than is noted on (2), where a much greater space intervenes between the lower

and higher branches. This is the great advantage (1) possesses over (2), and the gain will be more apparent as time goes on and crops of fruit are borne. Some of the disadvantages connected with the methods of pruning adopted in Fig. 22 are, (1) has too many shoots retained and too many buds are left upon each shoot. These errors give rise to a great number of comparatively weakly overcrowded shoots which, in the close struggle for existence, injure each other and form weakly main arms. (See apricot tree, Fig. 33). These being set very closely together, the lateral growths issuing from them will be choked out of existence, and the fruiting wood driven to the topmost shoots, thus defeating one of the chief aims of the short trunk, viz., keeping the fruit within reach and secure against rough winds, &c.

In (2) there is an excessive number left, and these are spread over elevations too varying to ensure maturity to all. The result must be that many of the limbs gradually perish or become barren along their lower portions. (3) Is typical of many local failures The tree has begun, in the natural course of vegetation, to set its main or scaffold branches, and the pruner "doesn't believe in interfering with nature," consequently he allows nearly 3ft. of stem to carry a few weakly twigs. This is the sort of tree that requires much support to stand against the influence of the prevailing winds, even before fruit is borne, and when it reaches maturity —supposing man and the elements have been kindly—it simply sprawls in umbrella fashion in the way of cultivation, or yields to the wrecking influence of strong winds. (See apple tree in Fig. 94.)



(1) (2) (3)

GROUND PLAN OF FIG. 25.

In Fig. 25 the pruning applied by many successful fruitgrowers is shown. In this illustration the bare stems measure from 9in. to 18in. in height. This, however, can only be correctly decided in the presence of local conditions, and with a knowledge of the erect or pendulous habit of the kind of tree under treatment. It may be taken as a good rule to follow that the greater its liability of exposure to the direct rays of the sun or strong winds the shorter should be the stem of the tree.

In the case of (1) advantage has been taken of the formation of arms in the nursery. The stunt it received in the nursery bed illustrates how a season can be gained in shaping the tree by a check being given to the terminal point during the early part of its first summer's growth; but this is only safe and practicable where it is very vigorous.

In (1) three main arms, radiating at regular intervals from, and set fairly distant above each other along the main stem are selected. They are pruned so as to carry a few plump healthy buds only upon each arm.

At this period we are seeking to furnish the tree with a limited number of sturdy main arms, which will be capable of carrying in due time without injury heavy weights of fruits and foliage. To attain this end advantage is taken of knowledge conveyed by Rule 4 in theoretical principles, which teaches that when a tree is in average good health the lesser the number of shoots allowed to grow from any branch the greater will be the strength of each individual shoot.

(2) is treated in a very similar manner, excepting that four shoots are retained to form the main arms. Whether three, four, or five main arms are best is a matter over which opinions vary; but the selection of three for most kinds of fruit trees is recommended, for the reason that in the subsequent subdivisions more room is allowed for the development of lateral fruit-bearing growths.

(3) shows the tree reduced in length to form a short stout stem. The height of the branching system as started voluntarily has necessitated the reduction of this tree, for all practical purposes, almost to the stage at which (1) stood when the check caused it to branch, and (3), in a year hence should be identical with the stage now reached by (1). That is, it will be pruned to fix the number of the main arms along the stem. It is pruned this year to start those arms. There is a distinct advantage in having a clean, healthy, strong, whipstick stem on which to begin; and 90 per cent. of our nursery trees could be shaped better if compelled to take this form when in the nursery bed. The grower can fix the height from the ground at which the main arms shall emerge to suit his peculiar conditions, when the trees received from the nursery are grown thus. In actual practice the pruning of the top should not be performed prior to the planting of the tree in its permanent position in the orchard, for the reason that the principal buds left upon the main stem or the main arms are chosen because their positions indicate the direction of future growths, and if any of these be damaged the symmetrical shape of the tree may be disturbed and the balance of the crown upset.

This design may be considered an arbitrary ideal, and be condemned by some persons as leaning too largely toward the class of tree affected by the amateur or the enthusiast, who does not view its results commercially.

The improbability that all trees can be trained as geometrically correct as our drawings imply is freely admitted, but the nearer they approach each other in this respect the more will such operations as pruning and cultivation be facilitated, as less time will be required to study the distribution of fruit-bearing wood, &c., over each individual tree. In other words, the subsequent prunings will be reduced more towards a mechanical effort.

At this early period in the shaping of our future tree I wish to reconcile our hard pruning with the physiological fact set forth in the first general principle, as at a superficial glance they may appear inconsistent.

We are about to form a strong tree, carrying only a few stout arms, and to do this we have trimmed it back to a few shoots, upon each of which only a very limited number of buds are retained.

This first principle claims that the leaves—green parts—of a plant are equivalent to the stomach as well as the lungs of an animal.

We have reduced enormously the number of shoots and buds upon the young trees under review, and thereby curtailed the formation of leaves.

It may thus appear that the plants are deprived of their means of development, and, instead of being strengthened in any direction, would be weakened generally to such an extent as to render that assumption untenable.

If we glance at Fig. 21 we will notice in (1) twenty-two buds started into growth during last summer, and these produced a combined length of 19ft. 6in. of branches—as measured prior to being photographed. The tree represented by (2) sent out thirty-four shoots aggregating 24ft. 9in. of growth. It will thus be seen that the lesser number on (1) averaged a greater length, and certainly produced stouter primary shoots.

The pruning shown in Fig. 25 will concentrate the energies of the tree into fewer channels still, and thus render those individually stouter, although the tree considered as a whole must be temporarily weakened. The leaf surface must necessarily be lessened in the early break of spring. As stronger shoots will send out many more and larger leaves than weak shoots, this discrepancy will soon be remedied. The average aggregate length of growth made in one season upon young trees thus pruned has been found by actual test to surpass that of similar trees left unpruned.

It will be readily seen on the ground plan, which shows the trees as they appear from above, that on (1) and (2) the shoots retained upon the main stem have been shortened back so that each one only possesses a few healthy well-developed buds. When growth begins in the following spring these will be encouraged to make the utmost progress.

The shoots near the end should be encouraged to grow as much as possible, and if any others start they must be pinched back from time to time during the summer season. This pinching should be regulated according to their respective growths. If a badly-placed lateral shoot shows a tendency to grow strongly, and in any manner endanger the claims of the selected leading shoots, it should have its topmost point pinched out frequently as it attempts to make headway. This practice should be extended to the leading shoots as well, under certain conditions. It will happen on every tree, and almost on every main limb, that one leading shoot—generally the upper one—will try to grow away from the others. This stronger one should be temporarily checked by having its young terminal point pinched out. This may be repeated several times in the growing season, and by the time the next winter pruning is done the two shoots can usually be operated upon equally. (See Figs. 120 and 121.)

It is sometimes advocated that all growths arising at this juncture (excepting those main shoots desired for the formation of the tree) should be removed as soon as they appear. This is scarcely to be recommended, owing to the need for again clothing the tree in leafage as soon as possible. Sheltering the bark from the fierce rays of the midsummer sun is necessary, but it is most essential that there should quickly be abundance of foliage to assist in the vegetative functions of the tree.—*Vide* rule 1.

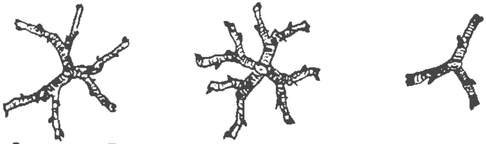
When the time for the second winter pruning arrives these trees should present somewhat the appearance of the upper illustrations in Fig. 26.

A few more short pinched spurs may be showing upon the lower arms and stems. The dotted lines indicate where the leaders (secondary arms) will be pruned, and the figures immediately below illustrate the trees when pruned. It will be noticed that a greater number of buds are left on each secondary arm than was permitted to remain on the main arm. Those are chosen which indicate that their future growths will

maintain the good circular shape of the plan of the tree. At this period any irregularity in the direction taken by any one of the main arms may be corrected by encouraging buds whose future growths are calculated to fill up the wider spaces or gaps.

When pruning in winter it will invariably be found that a certain unevenness of growth has taken place among the secondary arms. Some will be stronger than others, but such discrepancies will be fewer if the attentions mentioned above have been carefully rendered during the previous summer. These weaker shoots should be reduced to a lesser number of buds than their stronger fellows, and then in the next summer season the shoots from the stronger arm should receive very careful attention in the direction of pinching out their terminal points, for the purpose of checking them, to the gain of the growths from the weaker arms.

All things being equal, the growths made during the summer following the second winter pruning should be much stronger comparatively than those of the previous season.



GROUND PLAN FOR SECOND WINTER PRUNING.

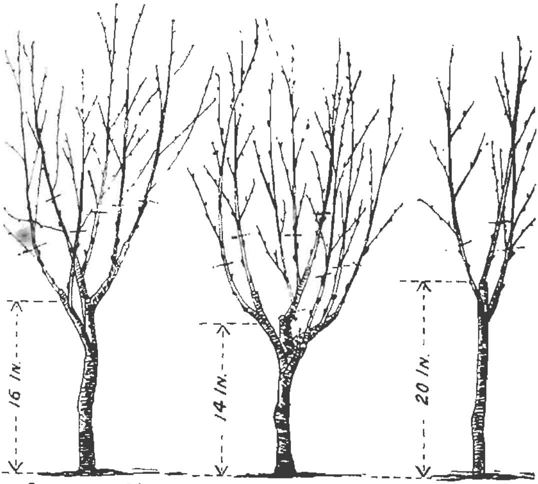
PART FIG. 26.

The root system has now regained its normal condition, and the reduction in the top made by this pruning will be repaired very rapidly by the tree, and thus a balance between roots and branches obtained once more.

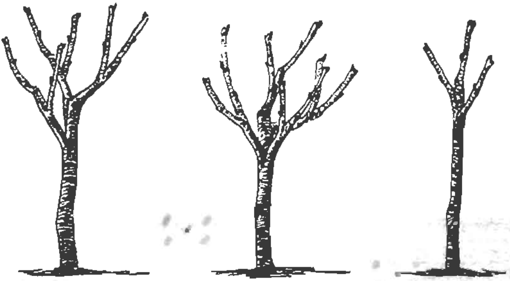
The growths from the secondary arms—made after the second winter pruning—will be treated in a manner similar to that laid down for the previous year, excepting that laterals upon them will be viewed with regard to their future welfare as fruit producers.

Fig. 27 conveys a fair idea of the condition of these trees when the time has arrived for the third winter pruning. The dotted lines indicate the points at which the leaders should be severed. These shoots would be allowed a length of from 12in. to 24in., according to the kind and strength of the tree under treatment. The pruning of the lateral shoots would be governed by the same considerations.

Fig. 28 shows these trees pruned, and the ground plan of each tree when so treated. We have now before us a tree with a short stout stem, from which radiate main arms, and from these come secondary arms, and from these again, leading shoots, all built upon strong principles; each, in fact, assuming the form of a vertical cordon clad in small fruit-bearing wood.



GROWTH MADE FIRST YEAR AFTER PLANTING.



SECOND WINTER PRUNING.

PART FIG. 26.

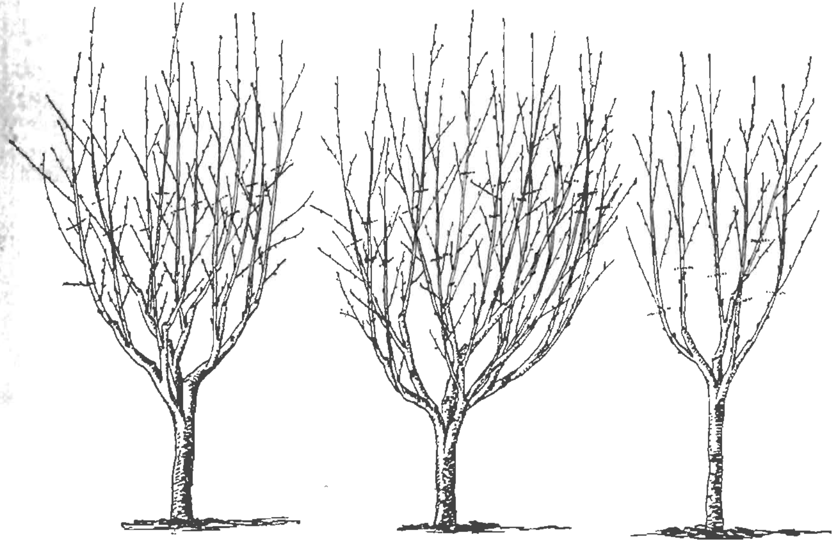


FIG. 27.—GROWTH AFTER SECOND WINTER PRUNING.

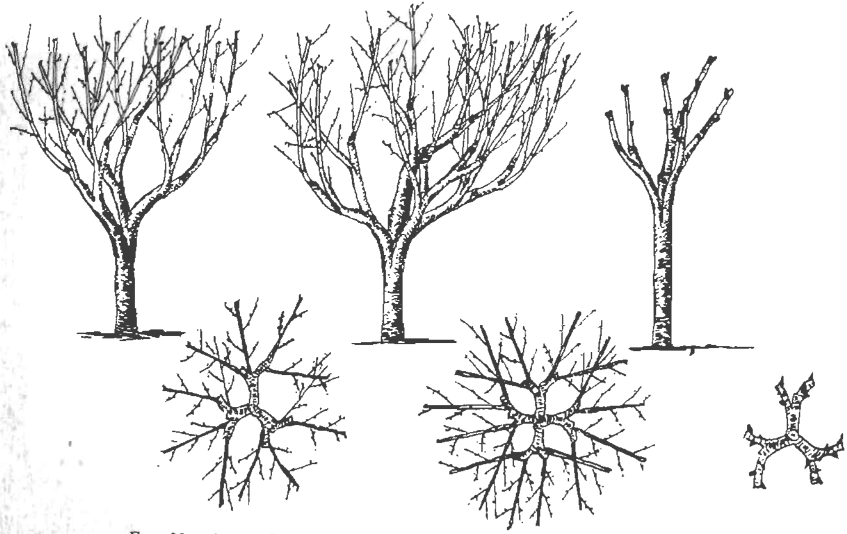


FIG. 28.—AFTER THIRD WINTER PRUNING, AND GROUND PLAN OF SAME.

Each recurring year will add to their lengths, as well as fresh layers of wood to augment their strength and enable them to carry the increasing burdens that fruit and foliage may impose. Every growth upon them has a useful mission, and each is directed towards the final object sought, viz., the securing of a tree which is capable of producing the greatest quantity of superior fruit at a minimum cost. The number of these cordon-like leaders which it is desirable to establish on each tree should be governed by the length of growth and tenacity of life displayed by the laterals of the various kinds of trees. The peach and nectarine, with long but comparatively weakly fruit shoots, requiring frequent renewal, have not room for more than six or eight. The apricot has shorter fruit wood, hence from eight to 12 leaders may be laid in. The sweet cherry, pear, apple, plum, and almond may be framed with any number up to, say, 15 leaders, owing to the slowly extending habit of the laterals of these kinds of trees after the fruit-bearing age has been reached.

With but few modifications, calculated to conform with natural peculiarities, this design is applicable to the peach, apple, apricot, nectarine, quince, plum, pear, cherry, almond, and fig. The pyramidal form is, no doubt, the natural shape for the pear, but it is yet an unsettled question whether, under the costly conditions of labor in Australia, the owner could train them to that ideal shape at a profit.

THE SPECIFIC TREATMENT OF DIFFERENT FRUIT TREES.

THE APRICOT.

The matured wood of the apricot is stiff and brittle ; consequently the best design for this tree is one with a very short, stout trunk, say from 9in. to 15in. high. The main arms should point away obliquely therefrom. Secondary arms and continuations should maintain the same direction. When the frame of the tree is completed, viewed in elevation it resembles a broad-based cone inverted. (See Fig 35).

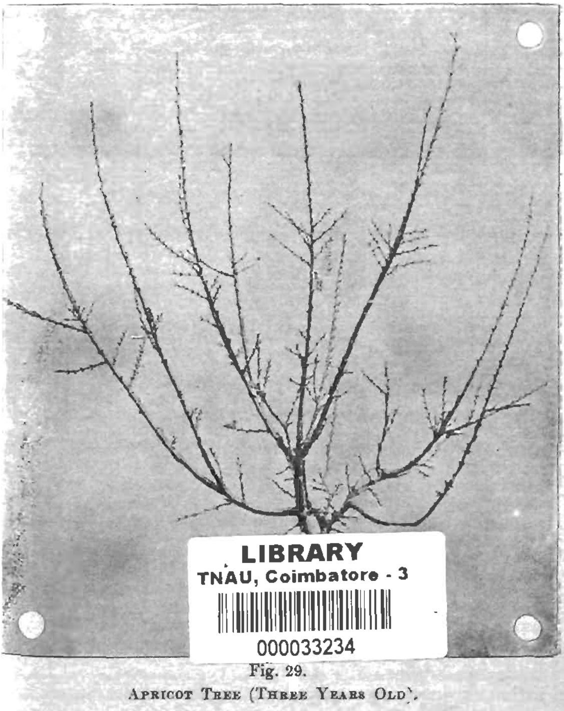


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Fig. 29.

APRICOT TREE (THREE YEARS OLD).

The permanent parts of the tree should be laid in stiffly by hard pruning. By this is meant that the top should rise slowly, so that the girth of the limbs may increase and strengthen correspondingly as the height extends and the weight upon them becomes greater.

Owing to the brittle tendency alluded to, each main arm should have a distinctly separate grip upon the trunk. If forks are allowed to form by two arms emerging on the same level there is great risk of a split occurring in later years.

The fruit-bearing shoots spring from all round the limbs almost as regularly as the spokes from the hub of a wheel: consequently the secondary arms and divisions from them should be spaced fairly wide apart. This will afford room for the fruiting shoots to extend, and permit light and air to pass around each one, thereby promoting healthy foliage and the even ripening of the fruit.

Fig. 30.

THE PREVIOUS TREE PRUNED.

We will now seek a few examples from the orchard. A young apricot tree nearly 6ft. high is shown in Fig. 29. It is trained upon the principles advocated herein, excepting that its base is somewhat broader than is desirable where horse-tillage is used. The progress of this tree may interest the beginner. In December, 1895, the seedling stem was budded opposite to the small black spot shown in front just below the first main arm. This spot almost marks the covered wound made by severing the top of the seedling stock after the bud had started. Strong growth arose from this bud during the remainder of the summer, and in winter (June, 1896) the shoot was cut off about 16in. from the ground. In spring three shoots were encouraged, and they made good progress during the growing season of 1896-7, forming the main arms. In June, 1897, these received the second winter pruning, and were cut back to

short lengths indicated by the first subdivision of the main arms. In the spring of 1897 good growth again ensued, and when the leading shoots had extended to about 2ft. in length they were cut back to where the highest subdivision seen in Fig. 30 takes place. The second growth began almost immediately, and the summer of 1898 produced the final extensions seen in Fig. 29.

It should be remarked here that the cutting back in the active growing stage, as mentioned above, is only permissible when trees are exceedingly vigorous. In such cases a season can be deducted from the time usually occupied in forming the tree This tree is practically formed, though only representing three seasons' growth from the bud. The photograph from which Fig. 29 is made was taken in June, 1898.

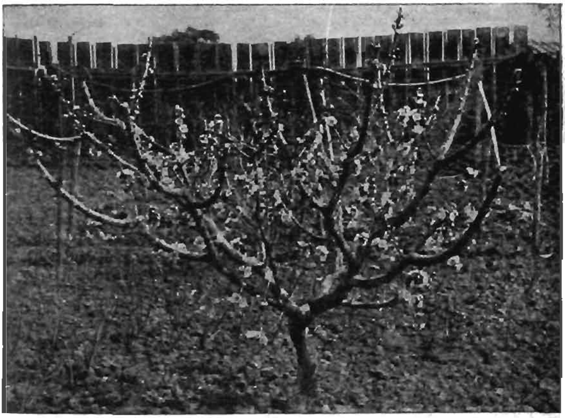


FIG. 31.

THE SAME TREE IN BLOOM, ABOUT FIFTEEN MONTHS LATER.

This tree now presents one of the principal difficulties which confront the beginner when pruning the apricot. The parts of the tree at present noticeable are the main stem, the main arms, the secondary arms, and the leaders representing the extensions after the second subdivision. Upon the main and secondary arms and leaders short horizontal growths are seen. These represent the fruiting wood. It will be noted that they are fairly consistently distributed upon the main and secondary arms. Upon the leaders, however, they are arranged in two separate groups. Herein may lie a pitfall to the innocent and the avaricious alike. In a previous chapter we have recognised these small branches as the fruit producers, and the beginner may consider the preservation of every available one important. If this policy is followed, and the leaders cut

off above the topmost clusters shown in Fig. 29, the sap will naturally flow to the highest point, stimulating the buds there, while those upon the lower portion of the shoots remain dormant. This would raise the tree rapidly in height without securing any compensating advantage

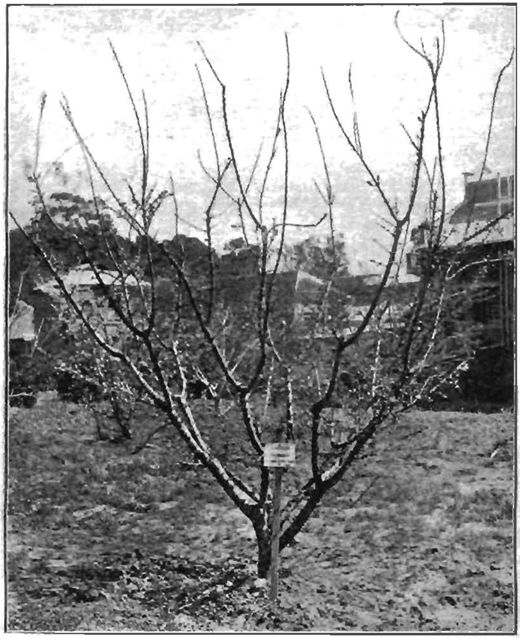


Fig. 32.

Apricot—Vigorous Tree at Sixth Pruning.

because the rush of sap to the top almost invariably causes the shedding of the flower buds. It would most certainly for the time being leave vacant spaces upon the leader, which should have been clothed in fruit wood, or at the best give rise to a multitude of short-lived twig-like growths. If, however, the leaders are cut just above the lower bunches of laterals, as shown in Fig. 30, good strong fruit shoots will be produced upon them. The leaders will extend in proportion with their strength, and every inch added to the height is utilised to its

Fig. 30 shows this tree pruned as described, while Fig. 31 conveys a good idea of the distribution of the flowering wood on the same tree a little more than 12 months later.

The tree now being framed, all future extensions must be considered in their relation to fruit production. The six-year-old tree in Fig. 32 illustrates this principle with fair accuracy, but having now reached a sufficient altitude the terminal points are now permitted to remain untopped.

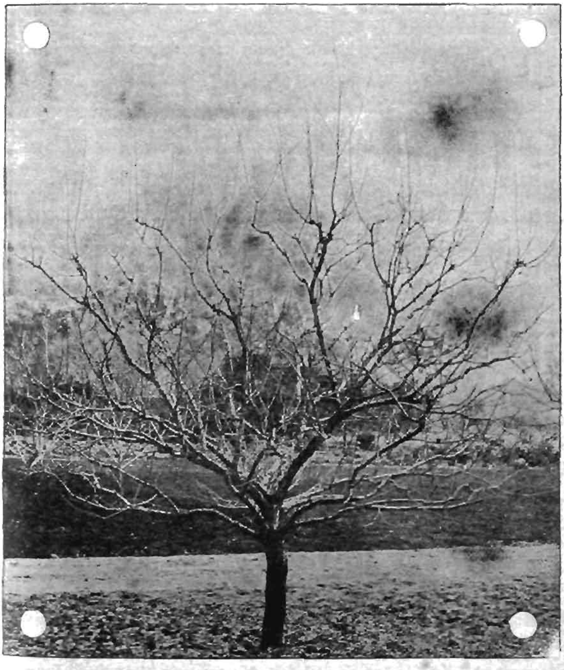


FIG. 33.—APRICOT TREE LACKING DESIGN.

In Fig. 33 the type of tree frequently seen in apricot plantations is figured. It has a stem about 4ft. high, and the main arms have arranged themselves as they grew naturally. Every shoot from the stem struggles to be a main arm. Owing to their closely packed condition, and the rapid

unregulated extensions made each year, the distribution of fruit wood upon them is very irregular indeed. The exclusion of light owing to overcrowding will rapidly kill off all of the fruit wood starting from lower and more horizontal branches. Each succeeding year will increase the risks of damage by breakage or wind-falls on such a tree. The cost of pruning,

FIG. 34.

AN EIGHT-YEAR-OLD MODEL AT ELLYTHORP, SOUTH AUSTRALIA.

harvesting, and treatment for diseases will increase in proportion with the elevation of the crown. The fallacy that such a type of tree permits of cultural operations being more readily performed by horsepower than is possible with later models is demonstrated when this one is compared with the modern types seen in Figs. 32 and 34.

Fig. 34 is an eight-year-old tree trained upon a definite system, and is a strong contrast with the tree in Fig. 33. It carries healthy fruit-bearing wood down to the main stem. Having only one tier of permanent limbs in its framework the centre is open and free from large vertical branches. Each year has added a short length to the leaders

FIG. 35.
THE PREVIOUS TREE PRUNED (NINTH WINTER PRUNING).

which maintain the shape of the tree, and every such extension carries its quota of fruiting shoots. The arms are stiff and unyielding when laden with fruit. The fruits are gathered without the use of stepladders. Pruning and spraying are performed from the ground, and, with the aid of a set over plough, cultivation carried on within a couple of spans from its 9in. stem. Fig. 35 represents this tree when pruned. Fig. 36 shows a splendid type of orchard tree much favored by more advanced growers

in the hotter districts, such as in the valley of the River Murray under irrigation. It will be noted that the foliage on the fruit wood of this tree most effectively protects its short trunk against the ill effects of sun heat, desiccating wind, and drifting sand.

FIG. 36.

TYPES OF ORCHARD TREES UNDER IRRIGATION, RIVER MURRAY, SOUTH AUSTRALIA (CONDITIONS HOT AND EXPOSED).

Thus far we have dealt with the framing of the tree, due regard being paid to the *production* of fruit-bearing wood upon each year's addition to its dimensions; we will now consider the best means to adopt to maintain this wood in an active fruitful condition over the longest period.

The Annual Wood and its Treatment.

Wood shoot or leader (see Fig. 38).
Fruit shoot (see 3, Fig. 39).
Fruit twig (see 1, Fig. 39).
Leaf spur (see 2, Fig. 40).
Fruit spur.
Leaf twig.

THE WOOD SHOOT OR LEADER.—As remarked in the previous chapter the legitimate function of this shoot is to carry on the extension of or to renew the framework of the tree, and at the same time give rise to fruiting wood. The length of that portion which shall be retained at each winter pruning cannot be accurately decided upon, excepting in the presence of each shoot. The object to be kept in view, however, should be to preserve very little more of the leader than can be clothed in fruiting wood, after allowing for the new leader or leaders.

In Fig. 37 the portion retained at last winter's pruning is shown from 1 to 2. From 2 to the summit represents the present winter's retention. It will be seen that the length decided upon a year ago produced the desired result in the form of good fruit wood from the buds on the lower

portion and the necessary leader at the top. The portion to be retained on the leader in Fig. 38 extends from X to P. Owing to the susceptibility of the apricot wood to die back after pruning, when severing a leader the pruner should make the section quite half an inch above the topmost bud which is retained. As previously mentioned, every node on the

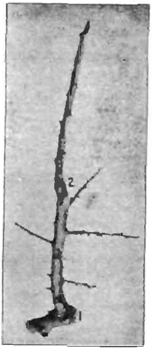


FIG. 37.—A LEADER ON A FULL-GROWN TREE (PRUNED).

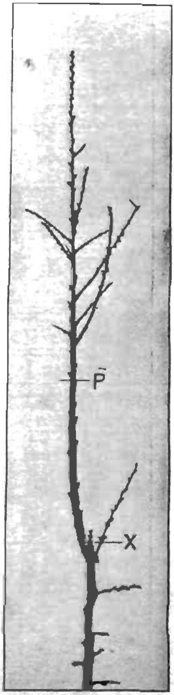
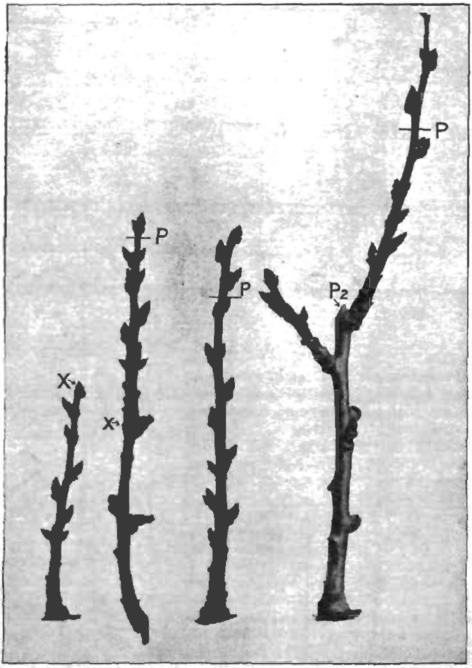


FIG. 38.—THE WOOD-SHOOT OR LEADER FROM X, WITH SUGGESTED PRUNING AT P.

wood shoot possesses a reliable leaf bud, consequently that one which points in the direction the leader should go to maintain the symmetry of the tree is necessarily selected to give rise to next season's leader. A wood shoot which grows from a lower position on the framework of the tree (generally adjacent to large wounds), if not required to renew the framework, *i.e.*, replace a worn-out limb or arm, should be checked back at midsummer as soon as its rank nature is discovered. If allowed to persist until the winter pruning season such a shoot will not only have robbed other fruit wood of light and sap, but its amputation will give rise in the following summer to other rank wood shoots. Under certain climatic and cultural conditions wherein the apricot makes extremely vigorous growth it is apt to display shy bearing characteristics. In such cases it is often found necessary after the framework is built to permit the leaders to go unpruned for a season or two, or to adopt the practice of turning the terminal growth

off into a lateral suitably placed for maintaining the direction of each limb. In such cases this lateral is not topped. This form of treatment may be noted in Fig. 82. It has much to recommend it where irrigation is practised, but great care and watchfulness must be exercised as usually regeneration must be resorted to after a few seasons. This is necessary, as the leaders become clad in exhausted fruit wood, bearing degenerated fruit, and both must be renewed by heroic prunings.



(1) (2) (3) (4)

Fig. 39.

(1) Fruit Twig, Leaf Bud at X.
(2) Fruit Twig a Year Later.
(3) Fruit Shoot (Pruned at P over Leaf Bud).
(4) Fruit Shoot a Year Later.

[*All suggested Prunings marked* P.]

FRUIT SHOOT.—(see 3, Fig. 39). The fruit shoot is valued for the production of fruit, and as many as there is room for should be saved for this purpose. When its length exceeds 5in. or 6in. the shoot should be shortened, as indicated at P (3) Fig. 39, to promote a branching habit and thus ensuring that any further additions to it by subdivision shall be kept close to the parent limb. Such sections should always be made immediately above a leaf bud. Whether such a bud stands alone or is accompanied by one or more flower buds does not matter, its presence will secure a terminal growth of foliage to draw sap through the shoot. The length retained upon the fruit shoot must be ordinarily gauged from the position and number of the flower buds upon it. This shoot nearly always takes up an oblique or horizontal position, and as a consequence of this the flowers of the apricot set very consistently into fruit. It will be found that the flowers, from three to six clusters or joints, are capable of producing as many fruits as the shoot can bring to maturity without exhausting itself. When too many fruit shoots arise those thinned away should be severed over the pair of base buds located where the shoot joins the bark of the parent branch. Usually this practice results in awakening those buds into activity. By this means new fruit shoots are forced out to replace others which become worn out in cropping or destroyed by accident. As these shoots become subdivided again and again and extend away from their main source of sap supply, the annual additions decline in strength and it becomes necessary to shorten them back to where the first offshoots arose from the parent limb. If they fail completely, the whole of the shoot must be suppressed back to the parent branch. In this case the concentration of sap around the large wound may start a dormant bud in the old wood, and thus give rise to either a wood shoot or fruiting shoot of some kind to refurnish the space.

THE FRUIT TWIG is valued likewise as a fruit-bearing shoot, but if it is shortened death follows, either before or immediately upon the ripening of the fruit, as no foliage can arise without leaf buds to draw sap through it (see 3, Fig. 40). The pruning, therefore, consists of cutting the fruit twig back to its base buds if not required for fruit production in the coming summer (see 1, Fig. 40); but if needed for this purpose all pruning is withheld, and the terminal bud permitted to grow. (See 1, 2, Fig. 39). Sometimes, however, as shown in 2, Fig. 39, this twig extends into a fruit shoot, when of course it should be treated as such.

THE LEAF TWIG.—This growth is sometimes found upon seedling or unfruitful apricot trees when planted under unfavorable conditions, and in such instances no pruning other than thinning out some of the twigs is recommended. When, however, it grows upon some of the early ripening varieties, it should be carefully preserved, as its buds, after the manner of a similar growth on the apple, pear, and plum, may each give rise to spurs of a fruitful character during the following season.

THE LEAF SPUR (see 2, Fig. 40) is found chiefly on worn out fruit shoots, and the suppression of the parent shoot back to the spur nearest the permanent branch is preferable to any treatment meted out to the individual leaf spur itself.

THE FRUIT SPUR.—This, like the foregoing, is rarely produced excepting as a subdivision of a weakly fruit shoot, and its presence is usually an indication that the parent shoot requires renovation or renewal. As the fruit spur is tipped by a leaf-bud, it may, if growing

upon the fruit shoot close to the branch from which that shoot sprang, be tried as a source of possible renewal. This is most applicable when it is situated low down on the framework of the tree.

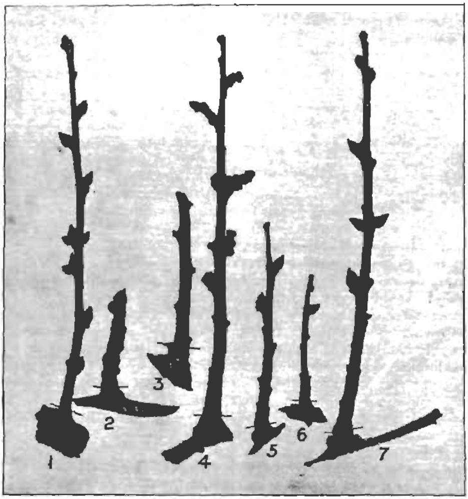


FIG. 40.

(1) FRUIT TWIG STARVED AND SICKLY.
(2) LEAF SPUR.
(3) FRUIT TWIG KILLED BY IMPROPER PRUNING.
(4) FRUIT SHOOT KILLED BY OVERCROPPING.
(5) FRUIT TWIG STARVED AND DYING.
(6) FRUIT TWIG STARVED (DEAD).
(7) FRUIT SHOOT IMMATURE (DYING).
[*Cross Lines indicate where to Prune these.*]

In Fig. 39 (1) represents a fruit twig, and (2) a similar twig with a year's extension upon it from X: below this mark several old dried fruit stalks are noticeable. No. (3) represents a fruit shoot, and (4) a similar shoot with the growth of another season upon it. The cross lines at P indicate the places for pruning where sections are recommended. The shoots shown in Fig. 40, represent weakly, immature, and worn

out fruit shoots and twigs, which should be suppressed to the cross lines above the swellings which show the positions of the base buds. No. (1) is a shrivelled, light-starved shoot, the bud and bark of which are dying; (2) is a worn out twig several years old and too weak to carry flower buds; (3) is a dead twig, killed by having its only leaf bud or buds cut off; (4), a fruit shoot worn out in the effort of fruit-bearing; (5) and (6) are stunted dead twigs which failed to survive through the summer which gave them birth; (7) is a fruit twig resembling (1), but its terminal leaf buds are insufficiently developod, resulting in death. The pruning away of these types of useless shoots each winter is a considerable aid in maintaining a full complement of fruiting wood along the permanent limbs, as well as preventing the entrance of decay to those most important parts.

Summer Treatment.

In the early stages of forming the young tree, green pruning can be utilised with advantage to regulate the growths upon the various leaders. The sappy growing points should be pinched out of vigorous ones to temporarily check their extension. This gives an opportunity to those more backward to get on even terms with them. Under the forcing conditions prevailing on rich or irrigable lands young apricot trees make exceedingly vigorous growths. In such instances much breakage from winds may occur if the branches are permitted to grow untouched throughout the season—usually the second and third seasons are most critical in this respect. To overcome this difficulty the exuberant growth is turned into useful channels—such as described at the beginning of this chapter—by framing the tree a season earlier than winter pruning alone would permit. This is done at midsummer, by cutting back the top-heavy shoots to the length they would have been reduced the following winter had they been permitted to remain unpruned till then.

The summer pruning, which may be utilised here to increase the productiveness of the apricot, consists of—

a. Thinning (rubbing) out of superfluous shoots of no value, to admit light to those retained.

b. Pinching out the sappy growing points of the stronger fruit shoots to assist the weaker ones immediately below them.

c. The shortening back to a length of about 8in. or 9in. of all wood shoots which may have arisen in the centre of the tree, or from some portion of it where they are not required to renew the framework. These will be noticed at midsummer, when the crop is being gathered. If such shoots are present they should then be shortened in the above manner, because sufficient activity still remains in the tree to start the buds on the portion retained into growths which usually ripen into fruit-bearing wood for the coming season.

d. Wherever two or three wood shoots have been permitted to grow from last year's leader the superfluous ones may be completely suppressed as the summer wanes, as no danger of renewed activity is thereafter anticipated.

The first-named operations—(*a*) and (*b*)—are performed in early springtime.

Beyond these practices it is very doubtful if any treatment is required in summer, providing the tree is properly and systematically framed and pruned carefully in the winter.

The practice of reducing all of the leaders by one-half their length *immediately after the fruit is picked at midsummer*, as advocated in

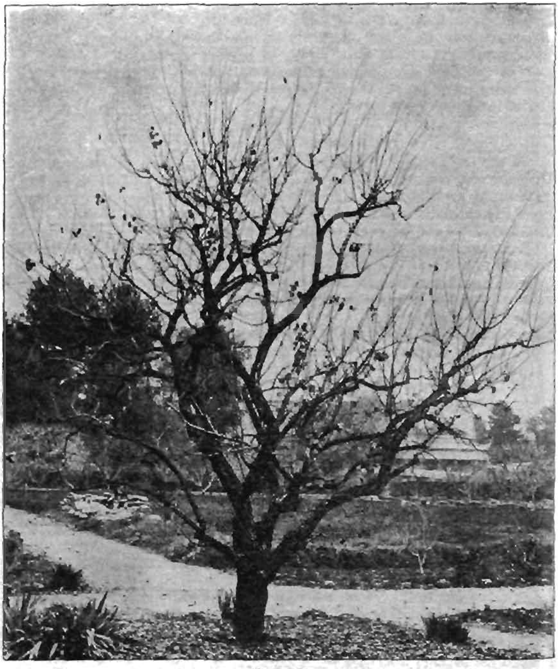


FIG. 41.

FORTY-YEAR-OLD APRICOT TREE UNDERGOING REFURNISHING PROCESS.

some countries, may increase fruitfulness for a short period; but it is not recommended here, owing to the fact that, if persisted in, it lowers the vitality of the tree, and brings on decay and death.

The Renovation of Old Trees.

In accordance with the care and skill bestowed upon the design of the tree, and constant attention given to the treatment of the fruiting wood, will the profitable period of its existence be extended.

Fig. 42.—A Horizontal Branch from previous Tree.

Notwithstanding all care, the inevitable tendency of the sap to furnish the upper parts will eventually cause the lower portions of the tree to become more or less bare of fruiting wood. There are two methods of refurnishing them with young wood. The most desirable of these is found in shortening back the leaders into wood several years old. That is to say, they are cut back just above the secondary main arms. This is shown to a certain degree in Fig. 41. Fig. 42 is a horizontal branch from the tree shown in the preceding plate. For this method to prove very successful the roots and the tops must be in a thriving condition. In performing this work it is always advisable to cut the old wood back to where a season's growth began, as seen in the shoot opposite to S S in Fig. 42. It will be readily noted that at such positions on the old limb the original buds have never started to grow, hence from dormant buds located there strong erect shoots may be confidently expected to arise and to form the new leaders. If this horizontal arm be examined closely it can be seen that the refurnishing fruit wood distributed along it has emerged from dormant buds located at the bases of dead shoots, the scars of which still remain. The pruner should note that there is usually a semi-circle of these buds around the lower edge of each original shoot. He can then readily understand how

successive shoots may arise therefrom when the proper stimulus is applied. This method of renovation does not wholly deprive the grower of fruit during any season it is in progress. The second method of refurnishing is more heroic, and reforming would be a more expressive term to apply to it. It simply consists of stumping the tree back to the main arms, and restarting the top afresh. This method removes all fruiting wood, and only permits the tree to gradually return to a cropping stage. It can be made a much greater success by reason of spring and summer manipulation, by which means the young shoots are judiciously thinned at the outset. If desired, it affords a good opportunity for changing the variety by means of budding into the young shoots.

The apricot tree shown in Fig. 41 is about forty years old. It is perfectly healthy and carries good crops. The secret of this is due more to the rich alluvial soil in which it grows than to any pruning applied to it. This tree has been shortened back quite unsystematically, and yet the results in the direction of refurnishing are fairly pronounced. By shortening-in the outside arms and removing the 20ft. high centre, young growth could have been obtained lower down, and the tree started upon a sound design.

THE PLUM.

Taken generally, the wood of the plum is pliable, and the inclination it exhibits during the first few seasons to make long slender growths has to be counteracted in framing the tree. A short main stem is desirable, owing to the susceptibility of the bark to sun scald. The main arms should be set sturdily by being pruned short the first year. The divisions

FIG. 43.
PRUNE D'AGEN, 10 YEARS OLD. "ELLYTHORP," SOUTH AUSTRALIA.

arising from them should, unless stout and vigorous, also be cut to fairly short lengths at the next winter pruning, but usually the length retained will considerably exceed that of the previous season.

FIG. 44.

A PRUNE D'AGEN, FIVE YEARS OLD.

[*The framework is excellent, but treatment of laterals too severe.*]

On well trained trees of average vigor the branches, after their third winter pruning, resemble the left-hand tree on Fig. 28. The main arms should be trained out obliquely, but owing to their tendency to bend outwards the secondary arms and leaders ought to be turned a little more towards a vertical position, as shown in Fig. 43. The same care should be observed in spacing the branches and regulating the number of leaders

to retain upon any arm as in dealing with the apricot. At the winter prunings, during which the main and secondary arms are chosen, it is most likely a good number of strong and superfluous wood shoots will have to be removed completely, but most of the weaker laterals springing from the outer faces of the limbs should remain uncut. When, however, at the third year's pruning a much greater length is left upon the leaders, any laterals may be retained and treated as described later on when dealing with the specific treatment of the annual wood. These will usually utilise a portion of the sap and check slightly the rank growth. The tree represeuted in Fig. 44 has a model framework, but the laterals (leaf twigs) upon its lower parts should have been left unpruned.

"A MODEL FRAMEWORK."

FIG. 45.—JAPANESE HYBRID PLUM, "HALE," SEVEN YEARS OLD, GROWN UNDER IRRIGATION, WAIKERIE, RIVER MURRAY, S.A.

As the crown increases in height and fills a wider circle, more divisions naturally are formed, until the number probably reaches 18 or 20 in a large tree, as illustrated by the Japanese hybrid shown in Fig. 45. Although perhaps somewhat less densely foliated, and more tenacious of life than those of the apricot, these shoots should be allotted plenty of space. The branching and persistent character of the lighter

fruiting wood makes this precaution necessary if each spur is to receive sufficient light to keep it in good health and productiveness. When the tree is formed and producing crops of fruit the tendency is for top extension to become somewhat stunted, in fact, almost unnoticeable.

It is not desirable, however, that the direction or dominant character of the leaders should be lost.

Fig. 46 is a fair type of plum tree, but Fig. 43 is more strongly recommended.

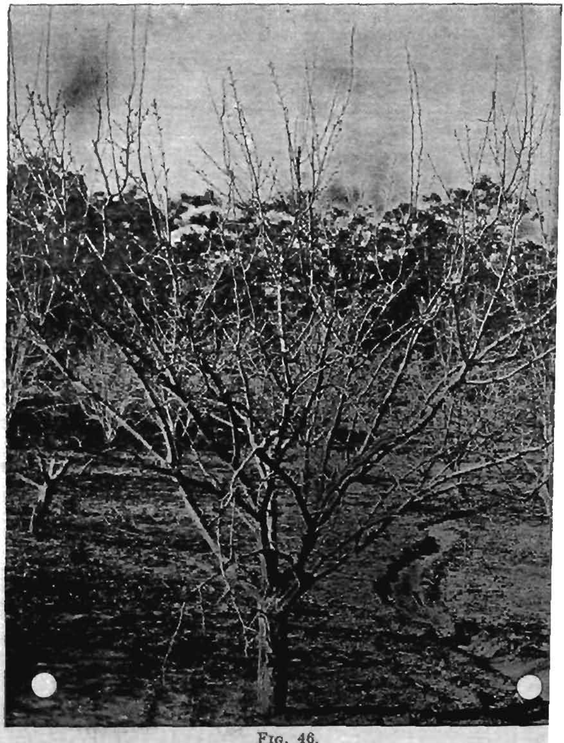


FIG. 46.
PLUM, "KIRKE'S," SOMEWHAT LACKING IN DESIGN.

This tree as pruned for immediate fruit-production is shown in Fig. 56, but since this photograph was obtained it has borne heavy crops of excellent fruit, and the owner has probably thinned out the leading shoots and given the head a shapely form.

Fig. 55.

Rank Growth from Buds of Burbank (Jap. Hybrid) Plum.

The chief advantages attached to allowing the top to run to such extravagant growth are found in quickly establishing a balance between root and branch, healing over the wounded sections, and the early return of the top to a fruit-bearing condition. This method can only be fully recommended for adoption when it is deemed desirable to test new varieties, or to meet a market which displays an extraordinary demand for the kind of fruit in question.

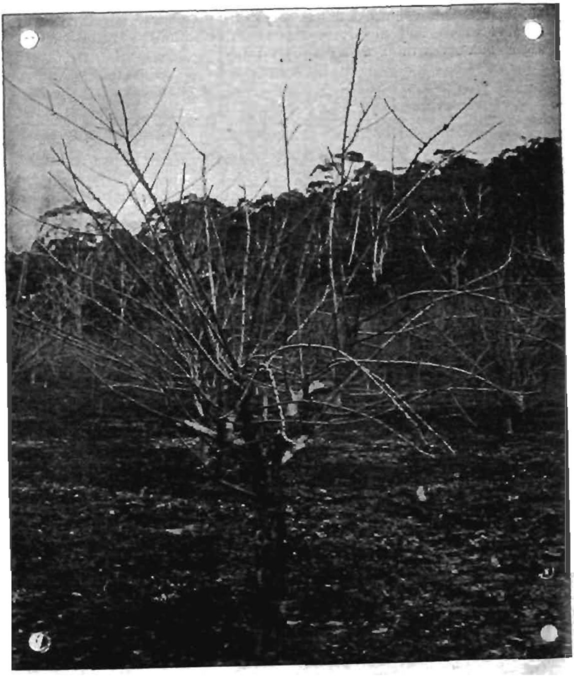


Fig. 56.

The previous Tree Pruned to Obtain a Crop without Delay.

THE CHERRY.

Where the soil and climatic conditions are favorable the cherry makes very strong erect growth during the first few seasons after planting. In this, as in many other respects, its habits resemble those of the plum. It is necessary at the outset to encourage this vigorous development, but to direct it in such channels as will prove useful throughout the lifetime of the tree. The erect habit of the sweet cherry lends itself to the formation of the inverted cone shape referred to previously. The stem should be short—never exceeding 12in. The main arms should be taken from buds set at even angles around the stem and carried in a slightly oblique direction from it. At the second winter's pruning they should be cut back moderately hard. The length retained will vary slightly with the individual strength of each leader, the thicker shoots being left a little longer than the smaller ones. In any case 12in. to 18in. will usually be the maximum length it is safe to retain. The third winter pruning should see the secondary arms again cut back to short lengths. They should be severed above where two side buds indicate that the resulting shoots will maintain the moderately upright original direction given to their parent branches. Fig. 57 shows the growth arising after the second winter pruning, and Fig. 58 the tree after receiving its third winter pruning. At the next winter's operations the leaders, if strong, would be permitted to retain much increased length, but the general direction given by those lower down would be continued. When the desired number of leading shoots have been obtained, no further subdivision should be allowed, and the subsequent pruning of the leaders is outlined in the description of the treatment of the annual wood.

FIG. 57.

CHERRY TREE BEFORE THIRD WINTER PRUNING.

The tree figured in Fig. 59 was started upon systematic lines, but after the main and secondary arms had been formed the growth went on undirected. This has resulted in an uneven distribution of the shoots.

The leaders have also increased in height out of proportion to their stability, and all the strong leaf twigs are striving to become leaders. Although the lower limbs are furnished more or less with fruiting wood, such wood must gradually be overshaded and robbed of sap by the more vigorous upper parts. The burden of the fruit spurs is shortly to be carried on the more slender upper shoots. This will soon bring them to a pendulous position, in which they remain, and cause their spacing to become more confused. This is to be noted on the giant cherry tree in Fig. 60. The equal diffusion of sap and the admission of a proper share of sunlight to each one will then become a difficult problem.

We can readily trace the terminal point of each season's leader by the series of whorl-like knots from which three or four shoots of almost even strength issue. These knots are serious checks to the upward passage of the sap, and certainly tend to turn the branches into a fruiting condition (See 7, page 4, Theoretical Principles.) This can be proved by observing on any tree the development of laterals beneath them. The presence of these clumps of shoots is due to the formation of several leaf buds close up around the terminal bud. If the annual pruning, which retains a single leaf bud to direct the extension, is not applied, this circle of buds starts simultaneously with the terminal one, and makes growth almost equal to it. Assuming no pruning is applied, this process goes on at the top of the leaders each year. Gradually, however, it weakens, and when it finally ceases some other method of rejuvenating the branches must be adopted. In Figs. 61, 62, and 63 three types of cherry trees found in our orchards are illustrated. The student will find many points of interest in working out the merits and defects in their respective shapes. As we have previously noted, the leaders retained on a full-grown cherry tree may be more numerous than on most cultivated fruit trees. This is because the spurs, after reaching a fruiting age, extend very slowly away from the parent branch. A glance at Fig. 64 will show how they emerge all around the shoot; consequently the pruner can see the need for the admission of abundance of light and air about each shoot carrying these spurs. It also explains the reason for making the leaders sufficiently stiff to prevent those above bending down to a harmful degree upon the others beneath.

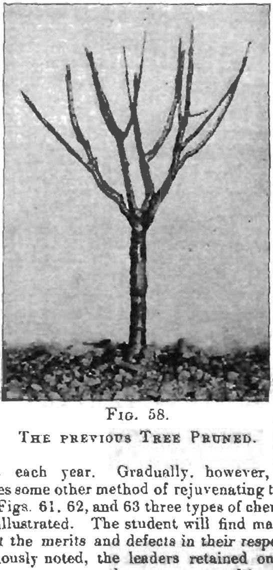


FIG. 58.

THE PREVIOUS TREE PRUNED.

The Kentish, or sour cherry tree takes a pendulous habit. To counteract this it is necessary to raise the body of the tree up by pruning the main and secondary arms as well as the leaders severely for

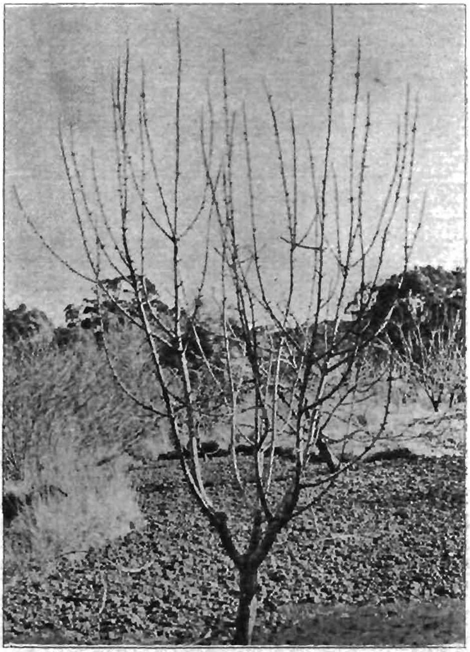
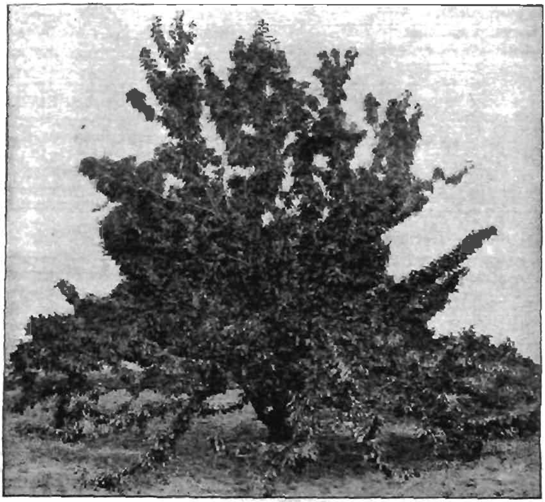


FIG. 59.
LOWER FRAMEWORK GOOD, UPPER PORTION INDIFFERENT.

several seasons, or by carrying the main stem to several feet in height. The buds selected to lead should point upwards—almost the reverse to that followed in training the sweet varieties. By carrying the crown up in this manner, when it comes to a fruiting age the leaf twigs may be

allowed to assume their natural willowy habit. As they settle into this the leaders should be spaced, and crossing twigs cut away from time to time to admit of a fair share of light reaching each of those retained.



"A Giant Cherry Tree."

Fig. 60.

Weakly Leaders Assume a Pendulous Position.

The Treatment of the Annual Wood.

The annual extensions found upon the cherry are as follows: –

Wood shoot or leader, A, Fig. 65.
Leaf twig, see 1, 2, 3, Fig. 66.
Leaf spur, see 2, Fig. 67.
Fruit spur, see 3, 4, 5, Fig. 67.

The Wood Shoot.—The foregoing description of the growth of the leaders on the tree at Fig. 59 permits the pruning of this shoot to be summarised as follows:—If the leaders continue to be produced stout and long after the full complement which is necessary to constitute the framework of the tree is secured, they should be allowed to remain unpruned for a season. To avoid the accumulation of the knots and whorls

alluded to, the next pruning season should see the tip which carries the cluster of buds removed from the leader. This, it is suggested, should be done sufficiently near to the end of the summer to avert a fresh start

FIG. 61.

A NATURALLY-SHAPED "WATERLOO" CHERRY TREE.

into growth. As is advised for the same shoot in other kinds of fruit trees, the pruning is based upon the fruiting or non-fruiting habit of the parent tree. It is desirable to maintain a moderate amount of advance each season, otherwise root action becomes too sluggish. Therefore

when it is desirable to turn excessive vigor into fruiting channels, leave the leader occasionally unpruned, or at the most only remove the partially ripened terminal portion. When, however, the decline of spur and wood shoot indicates all-round retrogression, arouse the activities of the tree by cutting the leader harder back into its more ripened wood, or even back to a strong spur below the objectionable knots.

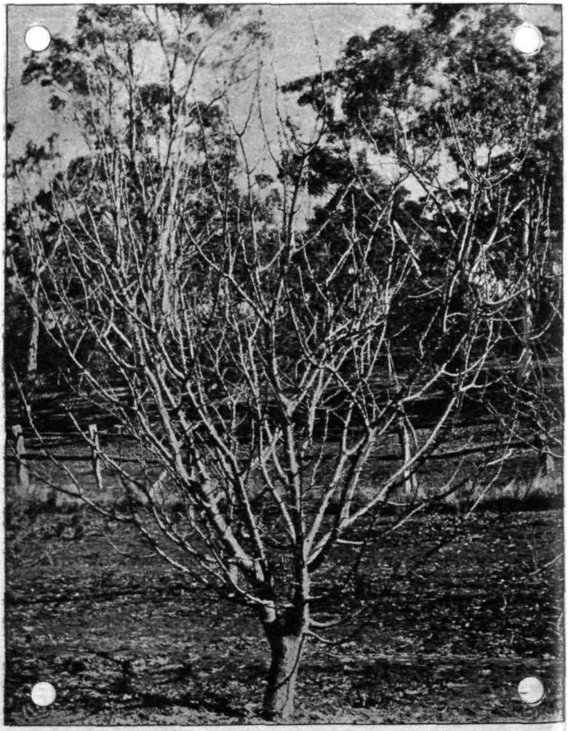


FIG. 62.

A "BLACK TARTARIAN" TREE ALMOST AS NATURE FRAMED IT.

THE LEAF TWIG.—Although the bud arrangement is identical with that of the foregoing shoot, its behaviour is somewhat different. Near the base of this twig several flower buds often form, and these may open into flowers. Assuming the shoot becomes restrained by the formation of leaf spurs upon it, as it usually does, these blooms may set into fruits. This twig, unless ungainly in length, is not pruned the first winter, but allowed to give rise to spurs from some of its many leaf buds, and, strange as it may seem, those near its extremities are most favored in this direction. *After a season or two the twig is "tamed" owing to the growth of spurs, and possibly fruit-bearing, and may be shortened back to any healthy spur situated in such a position as the condition of the twig demands.* (See 3, Fig. 66).

THE LEAF SPUR.—This growth may arise on the cherry from the permanent limbs as well as from twigs and leaders. It is not pruned, but allowed to develop on into a fruit spur, which is usually the culmination of another summer's activities. Many leaf spurs are, however, removed with the shortening of old leaf twigs.

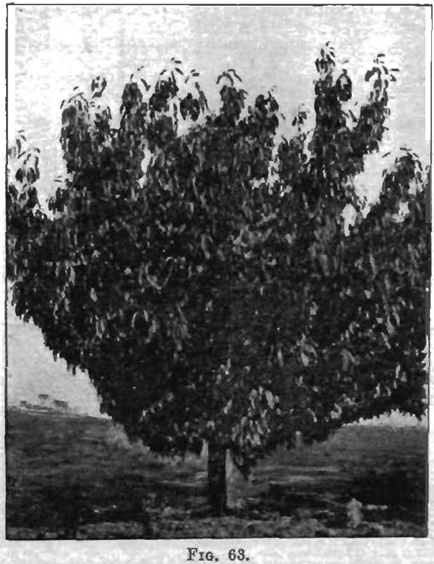


FIG. 63.

GOOD TYPE OF CHERRY TREE.

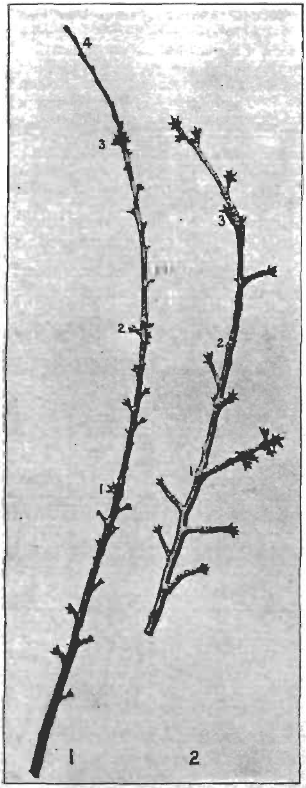


FIG. 64.
SHOWING THE ARRANGEMENT OF SPURS ON CHERRY SHOOTS.

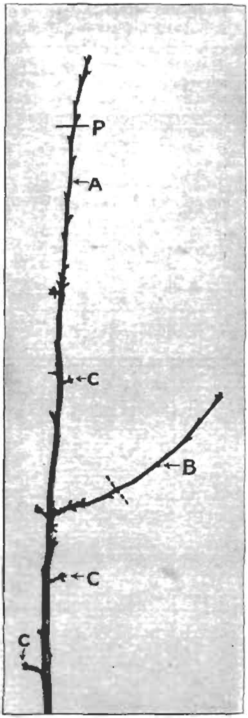


FIG. 65.
A—WOOD SHOOT TO BE PRUNED AT P.
B—LEAF TWIG (MAY BE CUT AT CROSS LINE.)
C. C. C—FRUIT SPURS.

FIG. 66:
(1) LEAF TWIG WITH FLOWER BUDS ON OLD BASE.
(2) LEAF TWIG ASSUMING A FRUITING HABIT.
(3) LEAF TWIG WHEN EXTENDED MAY BE CUT OVER A SIDE SPUR.
[*Dotted Lines indicate Possible Prunings.*]

THE FRUIT SPUR.—The acquirement of this form of growth is the aim of the pruner. Consequently, when attained, no pruning is applied to the individual spur until such time as the accumulated extensions of many seasons result in an attenuated and gnarled condition being reached, when the sap circulates too meagrely to compel the development of an ample supply of flower buds. When signs of this stage are detected the spur must be cut back to a subdivision, if present, near to the parent limb. If such be not available, nothing but the complete suppression of the old spur is recommended, when possibly latent base buds may be started into activity to fill the gap.

FIG. 67.
(1) LEAF BUD.
(2) LEAF SPUR.
(3) FRUIT SPUR.
(4) FRUIT SPUR (TWO SEASONS OLD)
(5) FRUIT SPUR (SEVEN YEARS OLD).

Summer Treatment.

Owing to the tendency of "gum" to exude from wounds upon the cherry caused by winter pruning, many observant growers express themselves in favor of pruning this tree during its period of active vegetation. It is stated that more rapid healing of the sections then take place, and this exudation is avoided. Where the conditions are *highly favorable to the cherry*, trees may be found which have been regularly and severely pruned in winter and yet show little or no damage in this direction. As a rule, fruiting wood forms freely upon the cherry, and no urgent necessity arises to produce that stunting effect for which summer pruning is applied. In the early stages of the tree's progress, pinching to regulate the shoots may be resorted to with advantage. When strong leaf twigs break into growth in undesirable positions, they may be checked by being completely fractured above the third or fourth bud from the base. Sometimes old extended spurs can be replaced by base shoots if the point of the spur be pinched out in the growing season. This throws the sap back towards the base of the spur, and may cause long-dormant buds to start into growth.

The Renovation of Old Trees.

With one or two exceptions old cherry trees do not lend themselves to wholesale cutting back, as is suggested in the reforming of the apricot and plum. The large wounds do not readily callus over, and, unless great care is taken, certain saprophytic fungi start upon the dead surfaces of the sections. In Fig. 68 a Black Heart tree, 27 years old, has been cut off and worked with a more profitable variety. There is great doubt, however, whether this top, vigorous as it appears, will succeed in healing the wounds made by amputating the original arms. The

gradual renovation of trees in fair health is feasible on the lines indicated previously for replacing leaders which have become unproductive. This is only practicable when the root system is capable of rejuvenation, for in most instances the failure of the top is only a reflection of the condition of the roots. It should be repeated that the promotion of steady top growth by means of the application of regular prunings will be found an important factor in maintaining steady progress at the roots. When, however, a tree is left unpruned for a long period of years, as many of

FIG. 68.

AN OLD CHERRY TREE RENOVATED BY BUDDING INTO SHOOTS ARISING FROM STUMPS OF MAIN ARMS.

our cherry trees are, and the topmost shoots reach a stagnated condition, the sap appears to settle back in a quiescent state into the lateral growths. This for a time gives rise to fruitage frequently in excess of the energy produced by root and branch, and increasing weakness results. A fruit tree must progress or retrogress. The neglect to apply rational pruning is often to blame for the latter condition prevailing.

THE ALMOND.

In many respects the almond tree possesses characteristics closely in common with those of the cherry. Each includes a group of varieties of erect habit, as well as one whose members exhibit dependent tendencies. The manner in which they develop fruit-bearing wood is almost identical; but the tenacity of life exhibited by the fruit spurs of the cherry is not repeated in those of the almond.

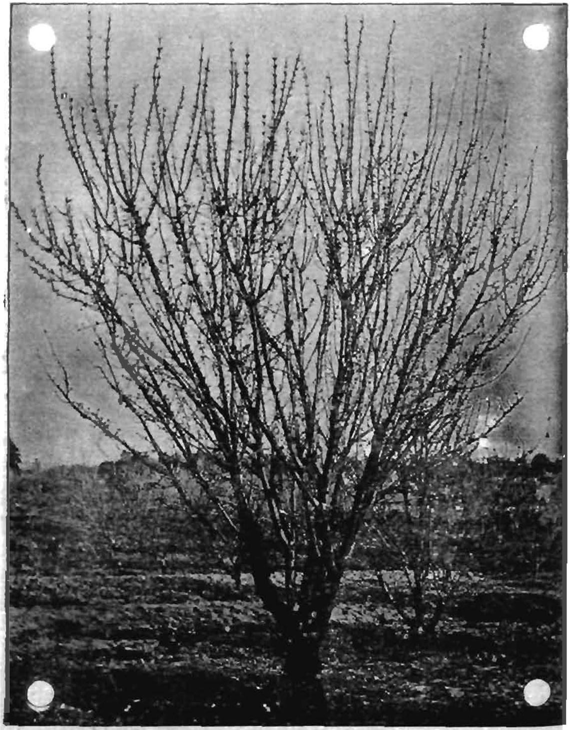


FIG. 69.
UPRIGHT TYPE OF ALMOND (BRANDIS.)

The matured wood of the almond is tough and hard. In consequence of this even the varieties with distinctly pendulous habits may be erected into sturdy trees. Judicious manipulation, however, from the *outset must be applied*.

Whether grown for sheltering purposes or in orchard form, the almond should be started upon a short stem. The main and secondary arms should be formed and spaced as carefully as possible. These will not

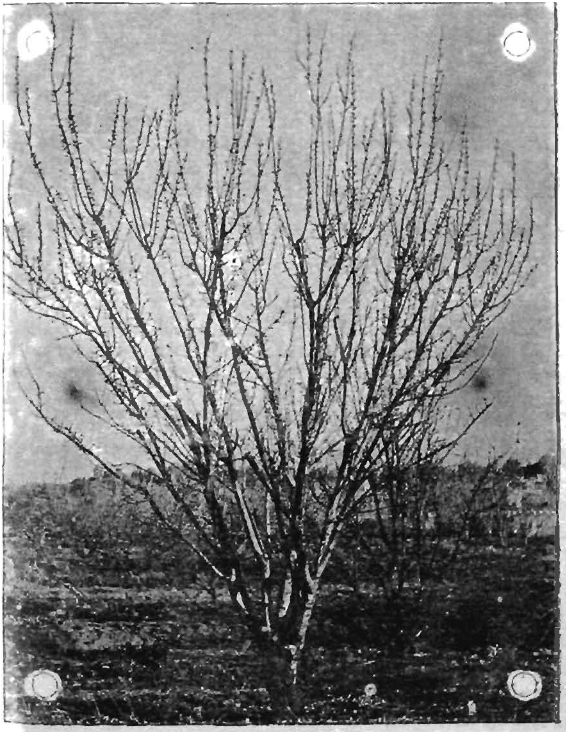


FIG. 70.
THE PREVIOUS TREE THINNED OUT.

be direct carriers of fruiting wood to any extent. With the tall-growing varieties illustrated in the Brandis these should be short and pointing away obliquely from the trunk. The varieties such as the Nonpareil, which have a drooping habit, should have the main arms set obliquely, but the secondaries should be turned again to a vertical direction. The latter sort or section also requires to be built up very sturdily in this position for several years. If this is not adhered to the

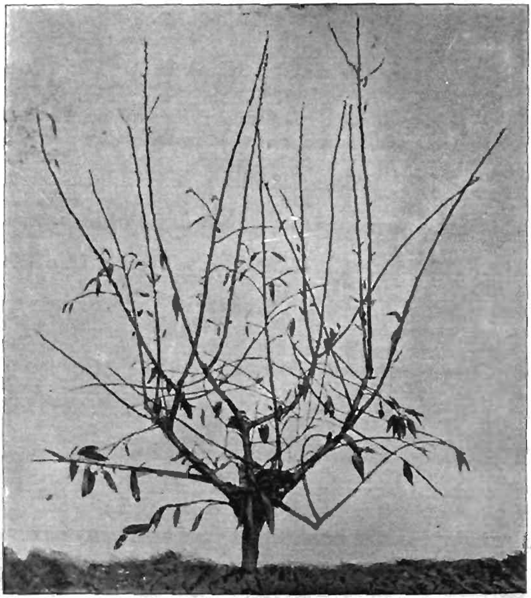


FIG. 71.

PENDULOUS TYPE OF ALMOND (HATCH'S NONPAREIL) PRUNED TO CORRECT DROOPING HABIT

pendulous characteristic will exert itself too soon for the shape to be attained which will permit cultivation to be carried on close up to the tree. After the main and secondaries are set on the erect-growing variety the tree should be allowed a good length of growth at the third winter's pruning. This will cause many of the buds upon this portion

to break out into short laterals or spurs, and thus the tree will turn to fruitage at an early age. At the next winter's pruning the greater portion of the annual extension upon the leaders should be retained. If further pruning of the leaders is deemed desirable, this process would be followed for a number of seasons, leaving a greater or lesser length of leader, just as the vigor of growth increased or decreased. The sub-divisions of the leaders would be permitted to increase in number, but not to the extent of injuriously overshadowing the fruiting wood located upon lower limbs.

As soon as any of the leaders fail at their tops, or the fruiting wood below begins to die out, the renewal of such limbs must be undertaken. Fig. 69 shows a typical tree of the erect Brandis variety as ordinarily grown. This tree is fruiting freely upon the upper shoots, but scarcely an almond is carried within 12ft. of the ground. This is largely owing to the upper parts having overshaded the lower limbs and drawn off pretty well all of the sap elaborated by the tree.

In Fig. 70 an attempt is made to show the first step in renewing the productiveness of the tree at a lesser elevation. This consists of cutting about one-third of the leaders back into the secondary arms. This course should be pursued for several winters until the whole of the top be renewed.

Fig. 71 illustrates a young tree of the Californian variety known as Hatch's Nonpareil. It is pruned with a view to correcting the pendulous habit and setting a sturdy base. The present leaders are seen to rise from inner and top buds, thus giving them a distinctly vertical direction. This tree was pruned on the lines described for the more drooping varieties of almonds, and the subsequent results are seen in Fig. 72, which is a photograph of the same tree several years later.

In Fig. 73 an almond tree as grown uninfluenced by the directing hand of the pruner may be seen. It is not a profitable tree, as quite half of the spurs are effete or dead. Although an object of beauty when it produces its myriads of blossoms in spring time, this type of tree does not recommend itself on its production of nuts.

The Annual Shoots and their Treatment.

The annual shoots consist of the following:—

- Wood shoot or leader.
- Fruit shoot.
- Fruit twig.
- Leaf twig.
- Leaf spur.
- Fruit spur.

It is not on economic grounds considered necessary to apply regular pruning to the above shoots upon the almond. The leaders are pruned as described in the foregoing explanation but there is much reason for suggesting that if a little more detailed and systematic attention were given to the lighter laterals the results would repay for the time thus spent. The shortening back of the longer fruit shoots after they have borne a crop, so as to concentrate the sap into a lesser number of spurs formed upon them, the cutting back to leaf buds which are located on the base of fruit twigs after those shoots have ripened nuts at their

extremities, or similar restrictions applied to the leaf twigs when their characteristics are clearly defined, would, in each case, tend to keep the lower portions of the tree clad in healthy fruiting wood. The reduction in number of the leaf spurs and fruit spurs when weakened or too numerous would follow as a matter of course with the shortening applied to the shoots upon which they are directly borne.

FIG. 72.

THE PREVIOUS TREE (HATCH'S NONPAREIL) SEVERAL YEARS LATER.

We have described in an earlier chapter how the almond bears its fruits upon lateral shoots and spurs after such have reached a certain development. We will now amplify the matter by considering the fruit-bearing wood in relation to the shoots, which in turn give rise to such wood.

At (1) in Fig. 74 is a leading shoot cut from the Brandis tree, illustrated in Fig. 69. Four annual lengthenings, as shown by so many numerals, may be detected. (Compare this shoot with 1, in Fig. 64, dealing with the cherry.) An examination of the original showed fruit stalks upon it up to 2, but

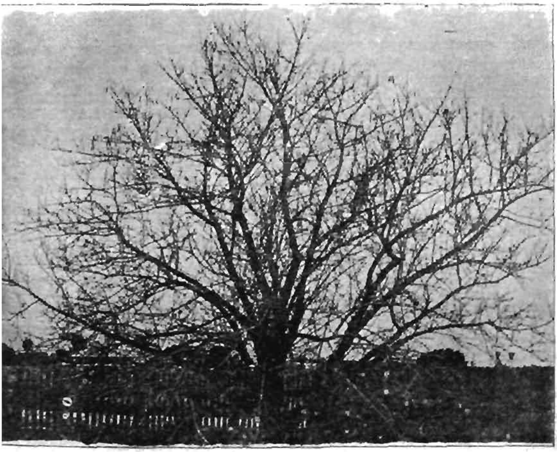


FIG. 73.

AN UNTRAINED ALMOND TREE.

not higher. Between its base and 1, 14 almonds have been produced. The buds on the short spurs on the portion of this shoot which is two years old, *i.e.*, between indicators 2 and 3, show freely for bloom. Those spurs on older wood below give similar promise. The erect terminal growth (the leader) made last summer, however, though showing the clusters of three buds – two for bloom and one for foliage – scarcely ever carry any fruits. Whilst the short fruit shoots and twigs immediately above the third numeral are similarly supplied with flower buds, and

doubtless, if growing in a less elevated position, they might have produced nuts. We have noted how, upon the leaders of the apricot, the leaf buds persist and the bloom buds are shed, owing to the rush of sap to these parts. Evidently the same law operates in the case of the bloom buds upon the leading shoots of the almond. (2) is a lateral—probably a leaf twig at the start—which has extended for several seasons, and which has had a similar career to that outlined in connection with (1), but its usefulness is pretty well over now. The terminal twigs are dead, and quite three-fourths of the spur growths have perished. Many fruit scars are left upon the lower portion, but its useful productive period ended a couple of seasons ago, when it should have been shortened back and a replacer started. If we return to (1) we see small clusters of spurs where a number indicates the termination of each season's growth. These show the positions occupied by the cluster of leaf buds which surround the apex of the leading shoot of the almond. Being almost on the same level, while the topmost bud extended, they grew evenly out as from a common centre, and formed a hard node or knot which always obstructs the free passage of the sap. This, as we have already observed in the cherry, checks the extension of the branch and changes its vigorous habit into one of quiescence, which is the fruiting habit. When this process of terminal checking is allowed to go on, the vigor of the tree or branch lessens year by year. The degree of weakness necessary to bring about fruit-production is soon passed, and the vitality of the shoot or tree declines and gradually ceases. If, however, before this stage was reached the terminal cluster had been removed each winter in favor of a single leaf bud, a stimulus to leader and root extension alike would have been given, and the vitality of the tree maintained on a fairly even basis.

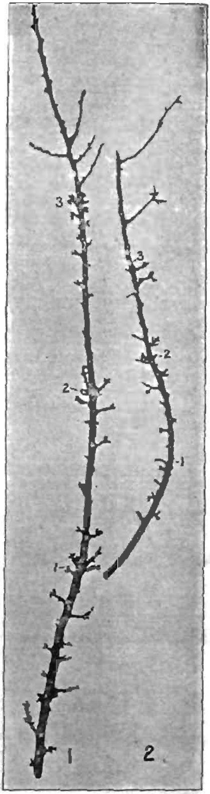


FIG. 74.

ALMOND SHOOTS SHOWING THE ARRANGEMENT OF THE SPURS.

Summer Treatment.

The green pruning, which follows upon the renewal system, is of great importance. When an almond tree is in fair health it

usually sends out a mass of young shoots below the spot from whence a large limb has been removed. If these are not thinned out they all grow more or less, and form a dense broom-like cluster. Such a number as may be needed as replacers should be selected while all are brittle and sappy, and the remainder rubbed out absolutely. In framing the young trees summer pinching may sometimes be profitably utilised to regulate the branches.

Renovating Old Trees.

Old trees of good varieties that have grown straggling may be cut off within a foot or two of the ground and restarted. The best shoots should be selected and encouraged to make growth to frame the tree. All others should have their growing points pinched out from time to time. This is better than removing them absolutely, as they, when pinched, help to shade the trunk and elaborate sap sent up by a now unbalanced root system, which otherwise might find vent by forcing up a mass of suckers. If the variety be inferior the same method may be pursued, and buds from desirable kinds put into the retained shoots close to their junction with the old stems. Particular care must be taken in pruning the growths from such buds. Usually they grow rankly, and summer pinching, as well as hard winter pruning, is often necessary to prevent them ascending out of proportion to their stability or hold upon the parent branch.

THE PEACH AND NECTARINE.

As the latter is only a smooth fruited variety of the former, for all practical purposes the pruning applied to both is identical in every respect.

Although naturally possessed of fair strength and pliability, the limbs of the peach have to carry at an early age a greater weight of fruit and leaves than that of any other fruit tree. Owing to its tendency to extend rapidly, and to run to wood at the top, the peach must be trained in such a manner as to be under ready control. Contrary to what has been

FIG. 75.

THE PEACH TREE AS USUALLY GROWN.

[*Note the absence of Young Shoots on Lower Limbs.*]

written heretofore in respect to other kinds of fruit trees, it always yields the greatest return when kept in a comparatively vigorous condition. A system of training that can be cheaply followed, and which affords an opportunity for this natural vigor being fully utilised, must in the end yield the best returns to the grower. The main stem should be short—a *guarantee of future stability; the main arms arising from it must also be* stout and short for the same reason. These arms should rise very obliquely from the stem, almost inclining towards the horizontal. This gives the tree a broad base, and makes the work of keeping

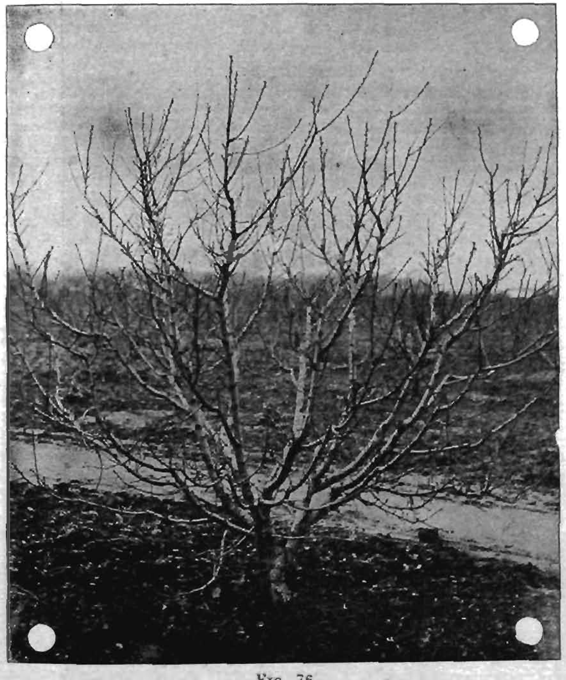


FIG. 76.

THIS TREE HAS TOO MANY MAIN AND LEADING BRANCHES.

[*Note the Outer Fringe of Laterals carrying Fruiting Wood.*]

the centre open and well lighted a much simpler task. The secondary arms should be well balanced and take a curved direction towards the vertical (see Fig. 77). With the peach these comprise the really permanent parts of the tree. All extensions from the secondary arms are more or less of a temporary character upon a peach tree kept in a thriving condition. The "temporary character" may mean many years

Fig. 77.

Peach carrying Regularly Spaced Leaders, each furnished with Fruiting Wood throughout.

or a very few, for such depends greatly upon the pruner and cultivator, providing nothing outside their control intervenes.

The peach fruits upon shoots made during the previous summer. It is necessary therefore to maintain a series of such shoots. The foliage of the peach is dense; consequently all shoots upon it must be spaced

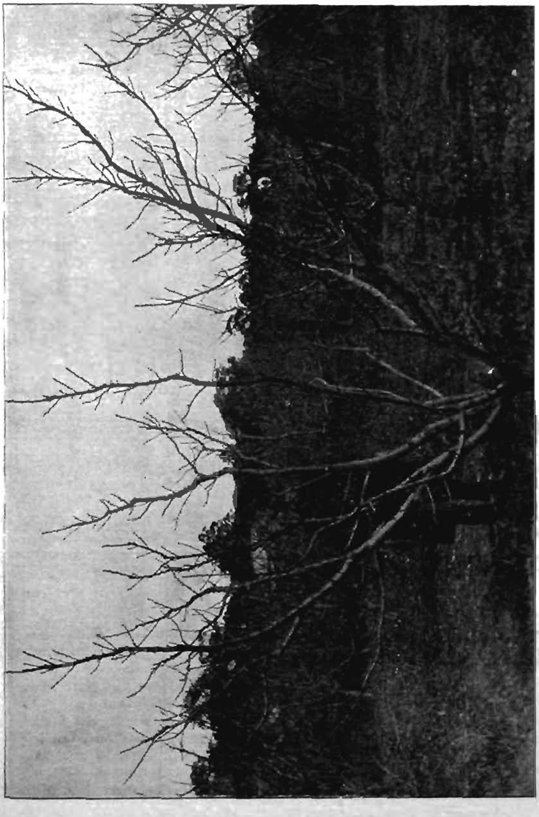


Fig. 78.

Nectarine Tree with Well Spaced Leaders, showing Distribution of Fruiting Wood.

and regulated so that each receives abundance of light and air. The shoots extend rapidly, and that part of them whereon fruit buds form bears but once. The next extension may cause any shoot to endanger the chances of several others. Each must therefore have space sufficient to mature its buds, whether they be intended for fruit-production or shoot-renewing. The natural habit of growing into a dense bush which a young peach tree when unpruned will assume operates very strongly against an adequate supply of sunlight reaching the lower laterals. It is therefore not surprising that under a system of pruning which simply clips off the tops of all shoots alike the density of the head increases year by year, consequently in a very few seasons all lower inside laterals are killed, and the annual extensions, which alone produce fruits, are confined to the terminal points on the top and sides. Fig. 75 gives a photograph of

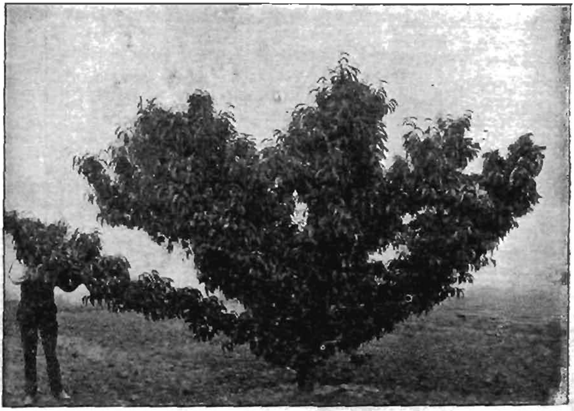


FIG. 79.

MATURE PEACH TREE (SALWEY), SHOWING PROPERLY SPACED AND FURNISHED LIMBS.

a rather superior specimen of the peach tree as ordinarily grown without systematic pruning. The process above described has, in the case of this tree, been fully carried into effect. Each year's addition to such a tree raises the fruit more out of the reach of the grower and into the zone of exposure to high winds. Fig. 76 shows another tree which has been more systematically trained. It is older than the previous one, but is still abundantly supplied with annual wood down to the main arms. A closer inspection of this tree shows that it is hollow in the centre, thus giving free access of sunlight to all lateral growths therein. The

secondary arms, however, are too numerous, and quite one half of them should now be completely removed. By reference to this figure it will be seen that extended laterals have grown like a fringe from the lower portions of the main and secondary arms. These should be encouraged to persist and bear crops for a number of years until the tree has steadied down somewhat in growth and it becomes possible to bring all of its

FIG. 80.

PEACH TREE BEFORE RECEIVING FIFTH WINTER PRUNING.

lateral growths into the condition shown in Figs. 77, 78, or 79. Any attempt to secure this compacted furnishing at an earlier stage in the growth of the tree usually results in the production each summer of great numbers of rank wood shoots from positions upon the tree's framework where they cannot be utilised.

The Annual Wood and its Treatment.

On the peach this consists of—

Wood shoot or leader. Fig. 82.
Fruit shoot (6). Fig. 83 ; (1) Fig 84.
Fruit twig (1) and (2). Fig. 83.
Leaf spur (4). Fig. 83.
Fruit spur (5). Fig 83.
Leaf twig (7). Fig. 83 ; (3 Fig. 84

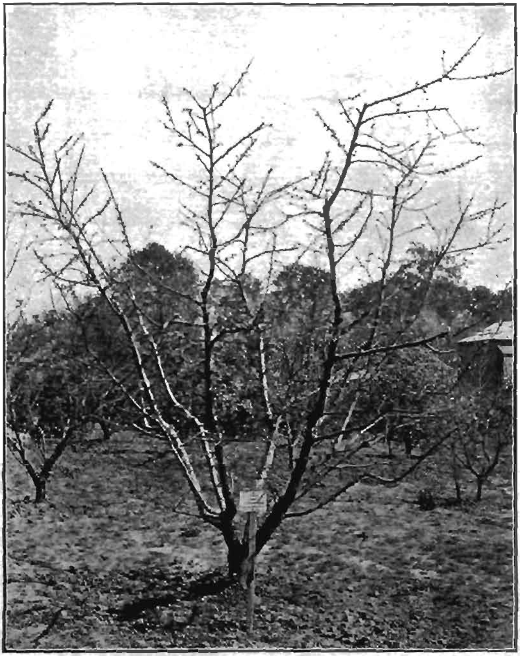


FIG. 81.

PEACH—VIGOROUS TREE AT SIXTH PRUNING.

THE WOOD SHOOT, when thick and strong, may be retained in greater length than a similar shoot growing upon most kinds of fruit trees. This course, however, is only recommended during the first season or two

after the secondary arms are set. At this period no difficulty is experienced in fully furnishing an extended length of leader with fruiting wood. Should the stability of the shoot warrant such action, no disadvantage is attached to seizing the opportunity of quickly bringing the

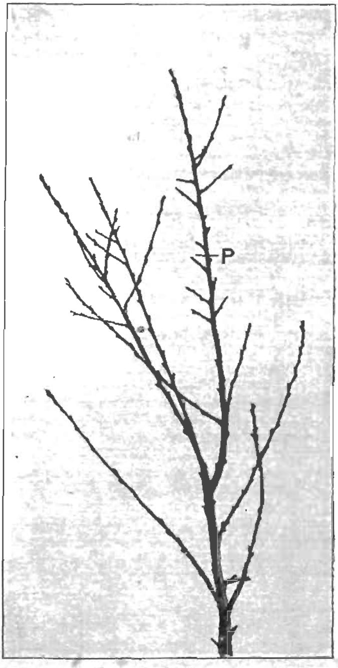


FIG. 82.
THE WOOD SHOOT OR LEADER.
[*Suggested Pruning at* P.]

peach tree to its normal stature, as indicated in Figs. 80 and 81. When the number of permanent leaders is secured—six or eight are usually ample for the peach—no other subdivisions are permitted to persist from the upper part of the tree, but at each winter's pruning the

best one to maintain the balance of the tree's top is treated as the leader, all other wood shoots being suppressed (if they have not already been dealt with) at midsummer as indicated under "summer" treatment. *The length of the leader retained on a tree of normal height at each* winter pruning will depend chiefly upon the vigor and fruitfulness of each individual tree. Rank-growing trees or shy-bearing varieties should be allowed plenty of extension, whilst weak-growing trees in need of stimulation should have their leaders cut short. In the former case the leader is usually left uncut, or if branched it is severed above a well-placed lateral for continuing the direction of the limb. This *lateral in such instances is not topped. The object of this is to avoid* drawing the sap unduly to the extremity, to the detriment of the lateral growths upon the lower parts of the arm. This is illustrated in Fig. 81; but whilst such a procedure is very useful under conditions conducive to strong growth, such as when grown under irrigation, it needs to be followed with extreme care and watchfulness to provide for renewing the leaders from shoots starting lower down on the limb before *complete exhaustion takes place*

THE FRUIT SHOOT.—This is the principal fruit-producer on the peach, and the following three important considerations should guide the pruner when operating upon it:—

a. *Its comparative vigor.*
b. Its direction of growth—erect, oblique, or horizontal.
c. The position of the flower buds upon it.

By way of illustrating these points, if a fruit shoot be moderately *strong, say 9 to 12 inches long, ripe, occupying a horizontal position,* and evenly clothed with good flower buds, the pruner can scarcely err in shortening it, for under such an aggregation of favorable conditions everything points to an abundant setting of fruit. In the presence of these shoots he can never safely lose sight of the truths contained in Rules 3 and 4 of our theoretical principles. In every case the shoot should be severed over a good healthy leaf bud. Some varieties of the *peach have a habit of forming flower buds towards the extremity of their* fruit shoots, and with these practically the whole length of the shoot retained for fruiting must be kept intact. As these shoots are often too numerous, and the refurnishing with fruit wood is to a certain degree an annual necessity on the peach, those not required for cropping in the ensuing summer should be cut back to their bases so as to force out new shoots of a like character for next season's cropping and manipulation (see treatment of leaf twig 3, Fig. 84). All other things being equal, the more vertical shoots should be cut back and the oblique or horizontal ones retained for fruit-bearing. Likewise, when the choice lies between two shoots otherwise equally eligible for fruit-bearing, that one should be cut back which arises nearest to the parent limb, thus compelling the emergence of replacing shoots from the nearest point to the main source of sap supply. (This is illustrated throughout the diagrams on Fig 85.)

THE FRUIT TWIG.—*This twig is also valued as a fruit-producer,* and it is obvious from the arrangement of its buds that any twig to be used for this purpose must not receive any pruning, because if the point is removed the remainder of the twig will perish in the succeeding summer *owing to the absence of foliage from it.* When not required for fruiting, new shoots may be forced from its base buds by cutting the twig off just above them (see dotted lines across 1 and 2, Fig 83). At (3) in

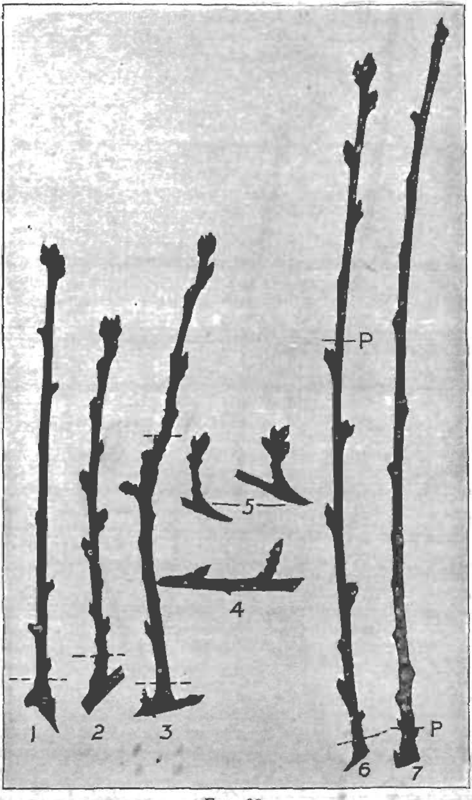


FIG. 83.

(1) FRUIT TWIG (NO BUDS HAVE MATURED BETWEEN BASE AND SUMMIT).
(2) FRUIT TWIG (NO *Leaf* BUDS FORM BETWEEN THE BASAL PORTION AND THE APEX).
(3) HOW (2) WOULD APPEAR A YEAR AFTER IF LEFT UNPRUNED.
(4) LEAF SPURS.
(5) FRUIT SPURS.
(6) FRUIT SHOOT.
(7) LEAF TWIG.

[*Dotted and Cross Lines indicate suggested Prunings.*]

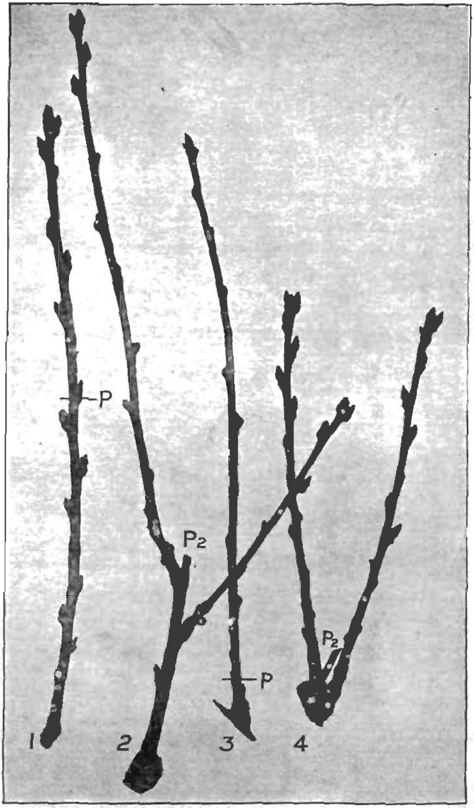


Fig. 84.

(1) Fruit Shoot.

(2) How (1) would appear a Year later if Pruned at P.

(3) Leaf Twig.

(4) If (3) be Pruned at P2 Base Buds grow like this

the same figure is seen the extension of the twig when left unpruned the first winter, and the suggested pruning a season later. Excepting on vigorous or shy-fruiting varieties, this twig should, as a rule, be suppressed to its base after it has fruited once.

THE LEAF SPUR.—This growth is of little use, and if retained there is but a remote possibility of it extending even into a fruit spur. Usually laterals carrying such spurs are shortened back to a single spur or suppressed completely. This growth is a sign of weakness, and it presents the characters of a very much modified leaf twig.

THE FRUIT SPUR.—Although valuable as a fruit-producer, the fruit spur seldom persists beyond the first time of cropping. It is either saved for fruiting untouched, or, if too numerous, some are suppressed completely, or the parent lateral from whence it arises is shortened back to its base or over the spur nearest to that part.

THE LEAF TWIG.—This shoot is barren and practically valueless excepting in so far as its buds near to the base are concerned. These may be used to give rise to new shoots which may possibly carry flower buds (see 3, and 4, Fig. 84 and 7, Fig. 83). To permit shoots to arise from the terminal portion of a leaf twig must inevitably result in undue extension of the lateral away from the framework of the tree. This, as has been previously pointed out, is not desirable upon the upper portion of the tree, but may be resorted to on the lower parts to a certain extent during the earlier years of its life.

In Fig. 85 the further possible treatment of fruit shoots such as are shown in (1) and (6), on Figs. 84 and 83 respectively, is continued. At (1) the base buds, leaf buds W immediately above them, and groups, chiefly consisting of two flower buds and one leaf bud characteristic of such shoots, are seen. The shoot has been cut off above the fourth cluster, where a good healthy wood bud is located between two flower buds. During the following summer the uppermost leaf buds upon such a shortened shoot would most probably grow better than those below. Fruits would also form if the flowers were duly fertilised. These growths from the upper buds would require pinching back in spring and summer to check the sap and induce the leaf buds lower down to develop. Next winter the shoot would resemble (2). The upper and lower shoots would stand apart, owing to the suppression of the growths arising from the intervening buds, as described under "Summer Treatment." The marks × indicate where fruits have been borne.

The second winter pruning consists of cutting away the upper portion at B completely; it has served its purpose and must pass out of existence, the right-hand lower branch being topped at C and retained for fruit-bearing in the coming summer. The left-hand branch, *because it is lowest down and nearest to the parent shoot and source of sap supply*, should be pruned at A to provide two replacing branches from its leaf buds. The usual summer disbudding and pinching would be followed during the next growing season. (3) Conveys an idea of the pruning to be done when the third winter arrives. The right-hand branch being at a disadvantage, has borne fruits (×), and made but weakly growths, hence it may be cut away entirely at C. The lowest shoot is again utilised to supply replacers by being cut at A. Its companion, topped at B, would supply the fruit during the next summer. (4) is simply a repetition of the previous season's work.

These diagrams are conventional, but are used to illustrate how the fruiting wood of the peach should be retained by renewals arising near to or

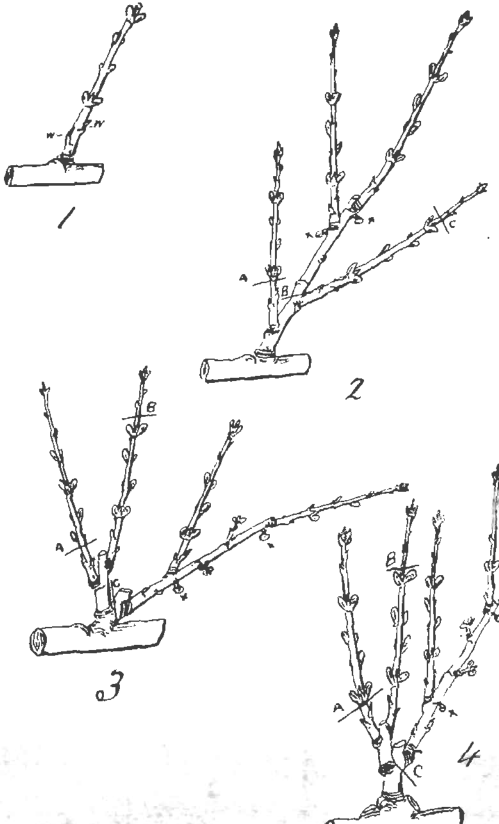


FIG. 85.
DIAGRAMMATIC REPRESENTATION OF THE PRUNINGS OF A FRUIT SHOOT FOR FOUR SEASONS.

upon the parent shoots. With the exception of the fringe of extended laterals, previously referred to as growing upon the lower and outer faces of the permanent arms, it should not be allowed to extend away further each year from the source of sap supply. It will rarely come within practical work to manipulate the old shoot for four years in succession. It is seldom necessary to do so, because base buds upon the parent branch will start under such a system. These should be manipulated like (1) and utilised as replacers as soon as they appear, in preference to trying to make the old shoot's base carry on the work.

There is, however, among the early ripening varieties, such as Red May, Early Canada, Alexander, &c., when kept in a vigorous condition, a marked tendency to cast their flower buds, and in consequence the retention of a basal portion of old wood upon the fruiting growths assists materially in avoiding this defect by retarding the flow of sap to the extremity of the shoot. It may be remarked in passing that these varieties fruit best when pruned very lightly in winter, but severe thinning to admit light should be adopted immediately after the fruit is harvested.

Fig. 86.

On a Newly Planted Peach Tree the Surplus Shoots arising from the Lower Part of the Stem should be Pinched Back, but not wholly Suppressed during the First Summer.

Fig. 87.

Previous Tree as often treated during the First Summer.

Summer Treatment.

The entire removal of undesirable shoots, or the pinching out of the points from over-vigorous leaders, may be made to play an important part in framing young peach trees.

The summer treatment of the peach mainly consists of—

a. The pinching out of sappy terminal points of shoots to temporarily check their vigor.

b. The complete suppression by disbudding of misplaced or surplus shoots.

c. Shortening in barren or partially barren shoots.

d. Removal of surplus leading shoots.

In Fig. 86 a young tree is photographed which had been pruned to a plain stem after being set out. In the spring buds started very irregularly upon it, and, if permitted to remain, there would have been two tiers of main arms. The stem, as cut after setting, reached a height of about 20in., which for the peach is excessive, unless ground frosts are prevalent in the locality. Fig. 87 shows a method of disbudding the lower shoots, and pinching applied to the strongest leader. These lower shoots, however, are best stunted by pinching from time to time in preference to absolutely suppressing them at this stage, as their foliage assists the tree in an assimilative capacity, and shelters the bark from drying winds or sunscalds. Some of such shoots may prove of value in balancing the head should any ruinous accident happen to the chosen arms Fig. 88 gives a very fair idea of this tree two years later, when it has reached a height of about 5ft. The over-vigorous winter pruning of the leaders, which is often resorted to, frequently causes an excessive number of shoots to arise from base and other buds upon the principal branches during the next spring. For this reason it is essential that they should be thinned out, and a greater length permitted upon those retained, as described in connection with the winter pruning of leading shoots when detailing the treatment of the annual wood.

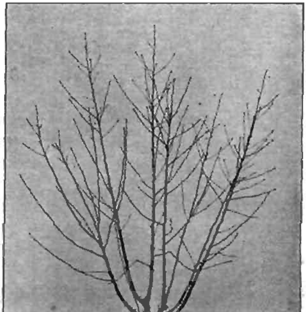


Fig. 88.
The previous Tree Two Seasons Later.

Fig. 89 is a portion of a branch, about 18in. long, carrying nine shoots—2in. of space for each one! It is scarcely necessary to say, if all are allowed to remain, none will be perfectly developed and furnished throughout with

properly matured buds The shutting out of the light would make them long-drawn and weakly, with the best developed buds nearest to the terminal points. Fig. 90 represents the same limb with all the shoots marked S suppressed, and at a later stage possibly some of those marked R would be removed likewise. In disbudding, the shoots arising from the tops of the limbs should be sacrificed, and those on the sides and beneath retained. This renders the equal diffusion of sap to all an easier task.

Attention to the peach is also desirable in summer to remove barren shoots. Frequently shoots retained for fruitage cast their flower buds either wholly or partially after the winter pruning. When the spring is well advanced, and the fruits firmly set, these can be dealt with very effectively.

Fig. 89.
A Limb Crowded with Shoots.

Fig. 91 furnished two such instances. (1) is about 15in. long, and more than half of its length is devoid of fruit and partly of twigs. There is nothing to be gained by such undue extension. Two twigs at the base, marked 1 and 2, and another, D, have no fruit near them. Of the others, marked P, each has a fruit at its base. The old shoot should be shortened to the young one accompanying the topmost, P, and the barren shoot, D, should be removed. If the shoots 1 and 2 remain backward the points of those above them should be pinched out. (2) on the same plate shows a shoot left to carry fruits, but they have failed to set. To avoid extension and provide replacing wood near to the parent branch, such a shoot is shortened back over the two lowest buds. Fig. 92 shows these two shoots pruned in the manner described.

As the summer proceeds it may be noticed that several leaders have grown from some of last year's leading shoots. These should be thinned out, and that one which is calculated to best maintain the proper direction of the limb, and thereby the symmetry of the tree as a whole, should be left intact to be dealt with at the winter pruning. The others should be completely removed.

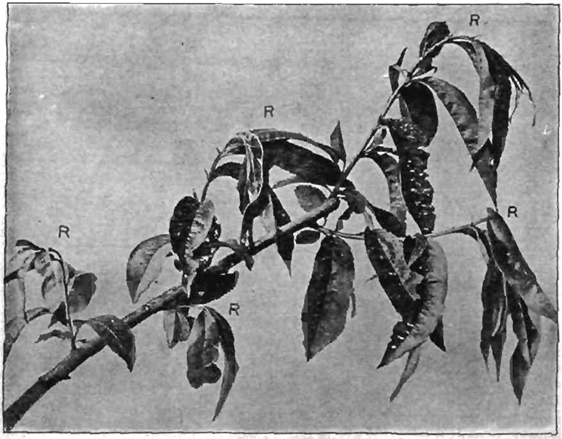


FIG. 90.

THE PREVIOUS LIMB WITH SURPLUS SHOOTS SUPPRESSED.

The Renovation of Old Trees.

There are two common methods of renovating the peach when grown into a straggling unprofitable form. One is to cut back the leaders gradually so that its completion is spread over a period of about three winters. While refurnishing in this manner a certain quantity of fruiting wood

is present each season. In doing this work it is advisable to cut over some side shoot, no matter how awkwardly it may be placed, so as to avoid cutting to a blind stump. Renovation of this kind should be begun as soon as the major portion of any arm becomes more or less bare of fruiting wood. Unless circumstances have been highly favorable and

(1) (2)

FIG. 91.

(1) SEMI-BARREN FRUIT SHOOT.

(2) WHOLLY BARREN FRUIT SHOOT.

the manipulation of the tree very skilfully carried out, usually after a peach tree is about 10 to 12 years old this process must be brought into use. It is more profitable to commence thus early than wait until all the lower portions of the limbs are in a denuded state.

Fig. 93 shows a peach tree nearly 40 years old, upon which this gradual process is being carried out in a somewhat unsystematic manner. Upon the refurnished parts excellent crops of good quality are now borne.

The second method consists of cutting the tree back into the main arms, with the object of forcing long-dormant buds to start. Unless the roots are very healthy, this usually results in a lot of trees being killed off. On those which survive it also frequently ends in an unbalanced top

(1) (2)

Fig. 92.

The Treatment recommended for the Previous Shoots.

being formed through the emergence of a few irregularly placed shoots. When it is successful it is more complete than the other method, and affords an opportunity to change the sort by budding into the young shoots. It, however, deprives the owner of all fruit for several seasons. The bark upon the old branches of the peach becomes extremely hard and dry without splitting to any great extent. It would appear that in consequence of this any surviving dormant buds have great difficulty in emerging. It is also a disputed point whether they retain their vitality upon the peach as long as upon most other stone or pip fruits.

Fig. 93.

A 40-year old Peach Tree undergoing Gradual Renovation.

THE APPLE.

In view of the great importance of the apple to the fruit-growing industry of Southern Australia, it has been deemed desirable to dwell at considerable length in these pages upon the treatment of that particular tree.

Where conditions are favorable the apple makes vigorous growth during the first few seasons after being set out. If only light pruning is administered the extensions from year to year ascend out of proportion to the stoutness required to support any other than the weight of their own foliage. When something like a normal stature has been reached the

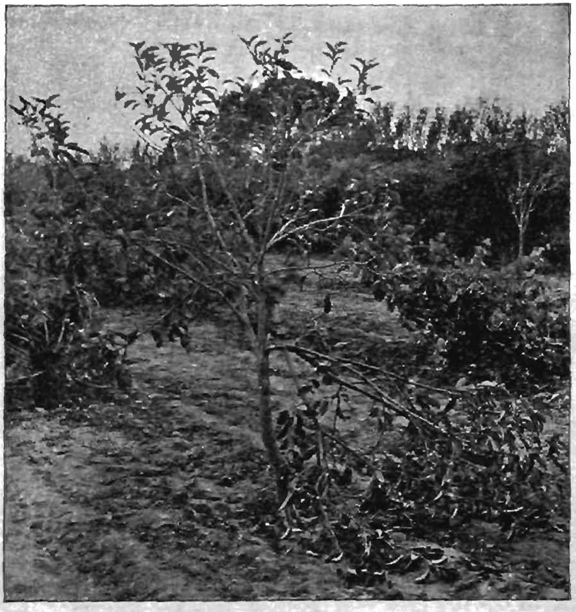


FIG. 94.

AN UNTRAINED APPLE TREE (CLEOPATRA) WRECKED AT THE FIRST CROPPING.

tree begins to assume a condition of lessened vigor, and fruits are produced. We have previously referred to the natural law which causes the upper buds upon any tree to secure the greater share of sap. In this case it is prone to develop the buds upon the upper laterals into flower buds in the autumn. The top branches, though least stable, are thus

Fig. 95.

Nickajack Apple, showing how the Fruiting Habit is developed on Shy Bearing Varieties by causing Branches to grow horizontally.

usually compelled to carry the weight of the first fruits, and this causes them to bend down upon those beneath. Before the fruits are removed the newly formed rings of cambium wood become stiffened, and such

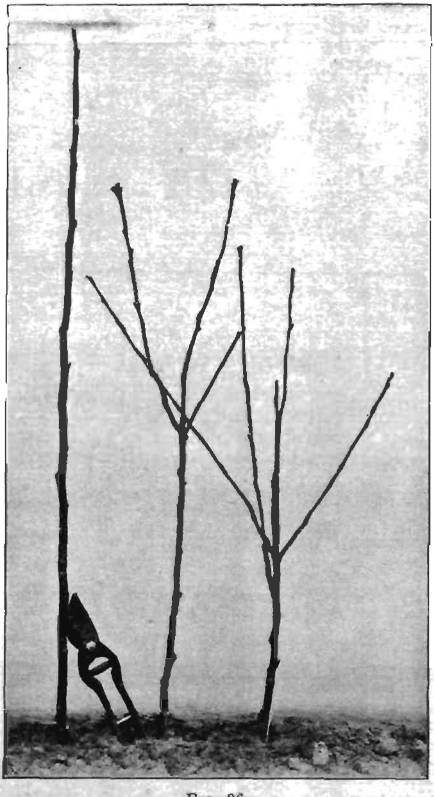


Fig. 96.

Types of Apple Trees from a Nursery.

attenuated branches then become fixed in this curved position. Very often the leaders do not bend sufficiently, and the weight of fruit frequently causes them to split and break off. (See Fig. 94.)

Nearly every orchard possesses standing examples of the accuracy of the above statements. This early vigor should be controlled and utilised in increasing the stability of the tree, so as to enable it to carry heavy loads of fruit without sustaining injury. The main stem should be set in a sturdy manner. Some growers prefer that it shall be of a greater length than is recommended here, but, in a windy locality, the higher the trunk the less the chance is afforded to the tree of maintaining its erect, well-balanced position.

Notwithstanding all that may be said to the contrary, for our conditions the short stem possesses many advantages in designing the apple tree. The main arms should be rigid. The angle they may form with the

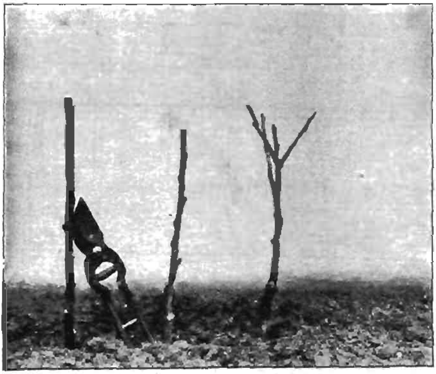


FIG. 97.

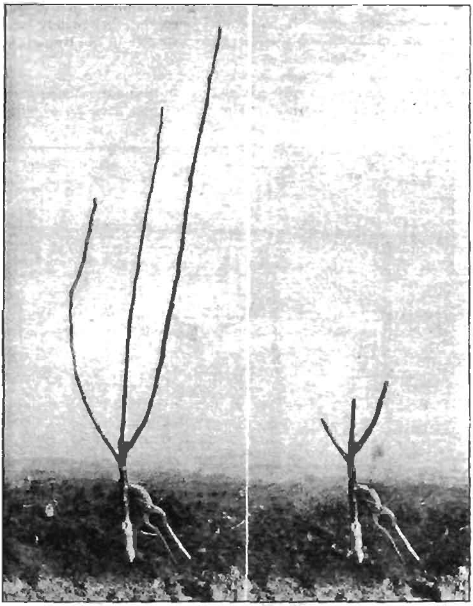
THE FIRST PRUNING OF TREES ON PREVIOUS FIGURE.

[*Secateurs 9in. long.*]

stem depends largely upon the variety. Erect-growing sorts, such as the Northern Spy and Nickajack (see Fig. 95), should be framed with broadly oblique arms; those of a more willowy habit, typified in Jonathan, Rome Beauty, and Irish Peach, &c., less so. To assure future stability the main arms must be pruned short at the second winter pruning, *i.e.*, the first time they are pruned (see Fig. 98). This will give rise to the secondary main arms (see Fig. 99). The third winter pruning, which is applied to the secondary arms, should also be fairly severe, but strong vigorous trees are cut not nearly so short as at the previous year's manipulation (see Figs. 99 and 100). For several succeeding winters the

leaders should be carefully watched, but hard pruning as a rule ceases when a rigid framework is produced to a height of five or six feet (see Figs. 101 and 102).

During this time numerous laterals (Figs. 114 and 117) will have formed *after each winter pruning*. All of those which rise from the inner sides of the permanent branches, and those which cross upon other shoots



(1) (2)

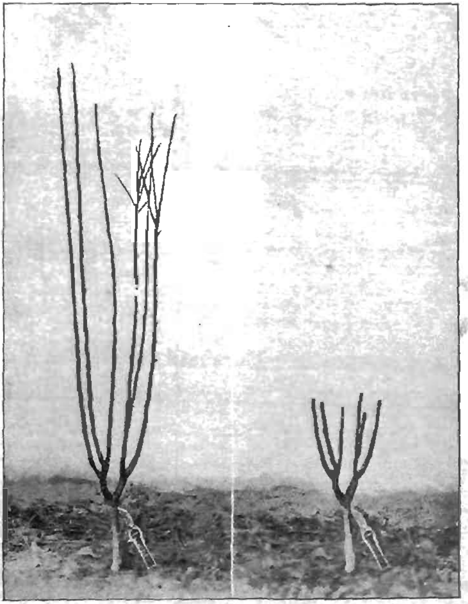
FIG. 98.

(1) GROWTH AFTER FIRST PRUNING.
(2) SECOND WINTER PRUNING.

which have emerged, as well as high up on the leaders, should be spurred back during the summer by methods to be described later on. Those which hang upon the outside of the permanent limbs should be retained where they do not exceed about 18in. in length. These will produce fruits fairly soon, and tend to check the excessive vigor of the

young tree. Such laterals do not interfere with the symmetry of the tree, and may be removed or shortened, as necessary, when the object for leaving them has been attained. When it is deemed necessary to wholly suppress a lateral in the winter, sever it over the bark rings to be seen covering ¼in. of its base. These lines or rings indicate the positions of partly developed buds.

When the tree has produced crops of fruit, and the spurs begin to ramify and extend as described later, they will require judicious thinning from time to time to make room for the expansion of the fruiting wood. There is a tendency for the mature apple tree when it has reached its



(1) (2)

Fig. 99.

(1) Apple Tree before Third Winter Pruning.

(2) Apple Tree after Third Winter Pruning.

[*On these strong Leaders a greater length should have been retained.*]

Fig. 100.

Another Apple Tree.

(1) Growth after Second Winter Pruning

(2) The same Tree after the Leaves have fallen.

(3) The same Tree after Third Winter Pruning.

normal size to sink into a comparatively stagnant condition. This for a number of years is a period of fruit-production and spur-augmentation. Gradually, however, under this process the spurs subdivide, become bark-bound and effete, and the tree begins to visibly fail, while the quality and size of the fruits at this period becomes irregular, and the cropping itself erratic.

FIG. 101.
APPLE TREE WITH GOOD FRAMEWORK.

We have previously discussed the need for regulating the vitality of the tree, when arrived at maturity, by pruning heavily or lightly, just as the resulting effects define from year to year. In no tree is this watchfulness more directly rewarded than in the apple. The domination of

the leaders should never be wholly lost, or the direction they take imperilled. The pruner should always remember that the reduction of the top extremities has a stimulating action upon a sluggish root system. Providing the roots are supplied with proper nourishment, this revival may be made permanent.

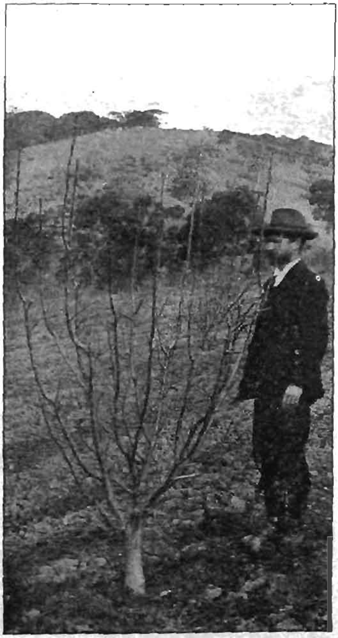


FIG. 102.

THE PREVIOUS TREE, WITH LEADERS AND LATERALS SHORTENED TOO SEVERELY.

Fig. 103 shows a superior type of orchard tree. This tree is about 12 years old, and is of the variety known as Sturmer Pippin. It would be difficult to find a more productive tree. The trunk and main arms are stiff, and the spacing is excellent. The old system of pruning away the lower laterals in winter has not been applied; consequently the lower

arms are fully clothed in spurs. The reader will observe that the pruning required by it now is very trifling indeed, and consists of thinning out the spurs, topping the few leading growths, and removing a few crossing branches.

Contrast this type with the orchard giant shown in Fig. 104, which has been made utterly devoid of fruiting wood up to 6ft. from the ground, also with a vigorous young tree of the Rome Beauty variety shown on Fig 105. The rapid ascension of the leaders on these has not

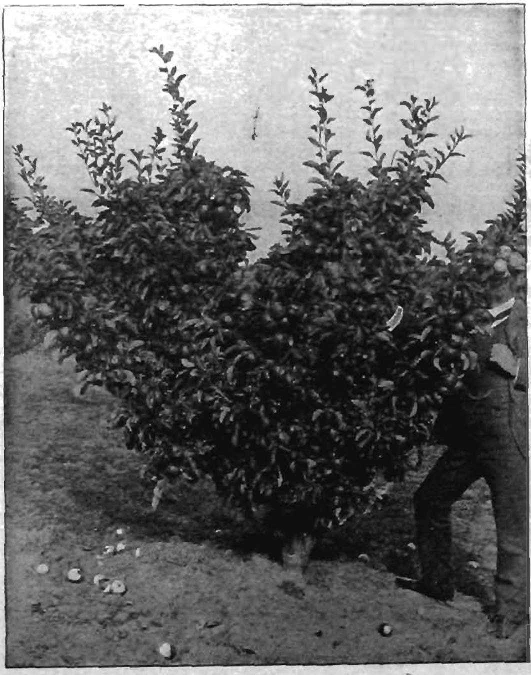


FIG. 103.
STURMER APPLE TREE.
A BAGDAD (TASMANIA) MODEL.

been regulated systematically. The bending down due to bearing the fruits upon their tops is noticeable with several branches. The leaders are too numerous, while laterals crowd and cross between the permanent

FIG. 104.
AN ORCHARD GIANT (ESOPUS SPITZENBURG).
[*A Type no longer sought.*]

limbs. The densely packed carpet-broom-like appearance of this Rome Beauty tree when in full foliage can be vividly imagined. An attempt at mitigating these defects is made in Fig. 106. It will be noticed that the leaders, though reduced in numbers, are not rigorously shortened. If the latter course were adopted the crowding evil would only be intensified. The object sought by this pruning is to turn the tree to a fruitful habit and to gradually correct any disabilities under which it grows. Fruit

FIG. 105.

APPLE (ROME BEAUTY) IN NEED OF THINNING.

spurs will develop on the upper extensions, and when they bend out of position the pruner would resort to shortening back the laterals and thinning out the leaders to prevent them overlapping lower branches. The pictures of a Scarlet Nonpareil tree in Figs. 107 and 108 are used to demonstrate how the permanent limbs, when provided with a sturdy base, may recline with the weight of crop, but immediately resume their erect positions when relieved of fruit and foliage.

FIG. 106.

SUGGESTED TREATMENT OF TREE IN PREVIOUS PLATE.

[NOTE.—*Limbs are removed, but none topped too severely.*]

In Fig. 109 a "two-storied" tree of the same variety is figured. In this tree the main leader has been allowed to persist and throw out side branches as it ascended. In a rigid, stocky, short-spurred variety such as this the "two-storied" type answers fairly well, as the position of the fruits does not cause them to exercise the same leverage upon the branches. The bending and overlapping are, however, fairly conspicuous, and in Fig. 110 the same tree has been improved by the removal of the "second storey." While pointing this out, it must not be understood that this type is recommended, because the stiff-growing varieties lend themselves particularly well to the inverted cone shape herein favored. One great objection to this type of tree is the obstruction it offers to cultivation by horsepower. In Fig. 111 an error frequently made in

FIG. 107.

APPLE (SCARLET NONPAREIL).

[*A type favored at Huon, Tasmania.*]

framing apple trees is shown. The main arms all emerge from a common centre, thus increasing the strain upon that spot. Should a split occur in later years the damage may be irremediable and the balance of the tree lost absolutely. The stem of this tree is about 4ft. high, and when the spurs formed upon the top branches bear fruit there is no doubt they will cause the limbs to open out and bend down, assuming the shape of an expanded umbrella.

The Annual Wood and Its Treatment.

Wood shoot or leader (A), Fig. 113.
Leaf twig (2), Fig. 114.
Fruit lateral (1), Fig. 114.
Leaf spur (2), Fig 115.
Fruit spur (3) and (4), Fig. 115.

The leader has been fully dealt with in the description of building up the framework of the tree. In the completed design of the apple, room can usually be found for 10 to 15 permanent leading shoots. Their dominancy should be kept inviolate, even though they make but a few inches of growth each year after the tree assumes a full fruiting habit. It may well be repeated here that after the tree has reached a normal size and

FIG. 108.
POSITION RESUMED BY THE PREVIOUS TREE WHEN RELIEVED OF FRUIT AND FOLIAGE.

stability the pruning of the leader is considered, not only in relation to maintaining a symmetrical form, but to regulate the vigor of vegetation of the shoot or the tree, just as may be required. The leaders on such trees as those in Figs. 103 and 108 should be cut very short in winter, so as to stimulate the activities of branch and root; whilst, on the other hand, those on a tree such as Fig. 101 should be allowed to go for a winter or two absolutely without topping, for the purpose of stunting the tree into forming spurs.

THE LEAF TWIG.—When this growth does not exceed about 18in. in length, and it arises from a part of the tree's framework which is stout enough to carry the weight of fruit, and when there is a space sufficient for it to hang or project, as there is around the outer face of the tree (see Fig. 126), this twig should not be pruned in winter until it has fruited or set spurs, as seen at (2) and (3), *Fig.* 116. Those leaf twigs which crowd between the permanent limbs, or project across the centre of the tree, or attempt to become leading shoots are best dealt with

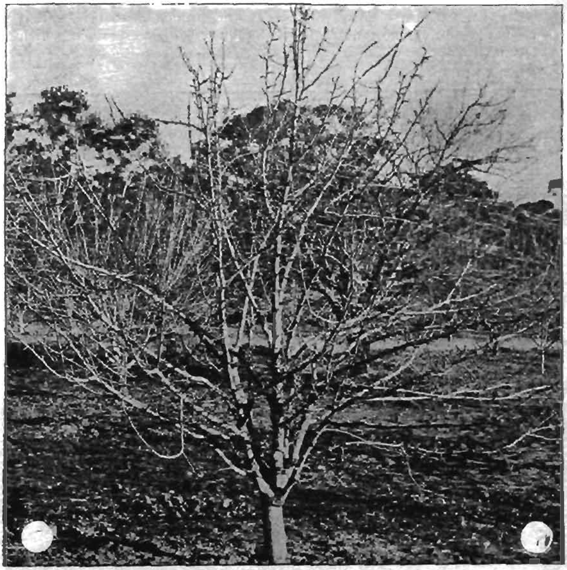


FIG. 109.

APPLE (SCARLET NONPAREIL).

[*A Two-storied Tree.*]

in summer. After the spurs are formed upon a leaf twig and fruits possibly carried thereon the twig itself may be shortened in, either by severing it through one of the groups of bark rings which indicate the terminal position of each season's extension, or above a spur situated at what is deemed a desirable length for the twig to assume for the time

being. This shortening back process should be performed gradually and with caution, otherwise an undesirable vegetative activity may be aroused, to the further postponement of the fruit-bearing habit.

THE FRUIT LATERAL.—This is only distinguishable from the leaf twig in the fact that a flower bud caps its terminal point. In consequence it may and often does form fruit the following summer if left unpruned. (See 2, Fig. 117). From any of the remaining buds spurs usually arise in the manner described for the leaf twig, and the subsequent shortening back treatment recommended for that shoot applies with equal force to the fruit lateral.

THE LEAF SPUR.—*This growth is never pruned. It marks that subdued condition most desirable, and requires no interference which is stimulating or retarding in effect.*

FIG. 110.

THE PREVIOUS TREE RENOVATED.

THE FRUIT SPUR.—Until such time as it has fruited and subdivided to such an extent that weakness and overcrowding become evident, no pruning is recommended for this growth. Then the shortening back of the much-branched spur to some of its lower divisions close to the parent branch becomes necessary. Whilst mainly performed with a view to infusing fresh energy into the spur, this operation can be made to act to a considerable degree as a regulator of the crop year by year, just in so far as the spurs or branches of spurs which are crowned with flower buds are reduced and spaced in alternation with those yet in the leaf spur condition. This is indeed an important phase of pruning which as

yet has not received that amount of consideration doubtless the future holds for it. The shortening of the old pear spur in Fig. 156 conveys an idea of what is suggested in the above.

Summer Treatment.

The summer treatment of the apple tree may be classified as follows:—

a. Pinching out sappy terminal buds of dominant leaders and vigorous leaf twigs to temporarily check their vigor.

b. The complete removal of portion of long developed leaf twigs.

c. The partial fracturing of such leaf twigs.

d. The complete removal of surplus wood shoots.

When building up the framework of the young tree the pruner will often note, during the first two or three seasons, the inclination of the top bud alone to grow strongly on some shoots. The next in position which may be required to form a branch of equal strength often remains dormant, or starts very feebly. (1) in Fig. 119 illustrates this. When such emergencies arise, the growing point, P, must be picked out from time to time until the lower shoot, S, is brought up to its proper condition of growth. If at the same time a crescent-shaped incision be made immediately above the stubborn bud, the ascending sap will be thrown back into it, thus causing the bud to display the desired activity. This trouble, as combated in a similar manner over several years, is shown in the young apple tree figured in Fig. 120. At each place marked P the sappy tips have been nipped out while growing, with a view to encouraging the left-hand shoot, W, to catch up to its right-hand competitor. The young apple tree referred to has by this means been brought to a well-balanced condition. Fig. 121 shows its limbs pruned so that each may have as

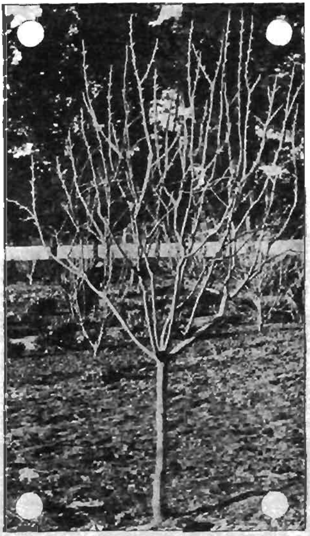


Fig. 111.

Apple Tree with Unstable Framework.

equal an opportunity as possible to share in the sap elaborated. It may be stated that the left-hand shoot, W, was pruned hard in winter, even while it occupied an unfavorable position. This was to give it thickness and stability, and to concentrate its energies into

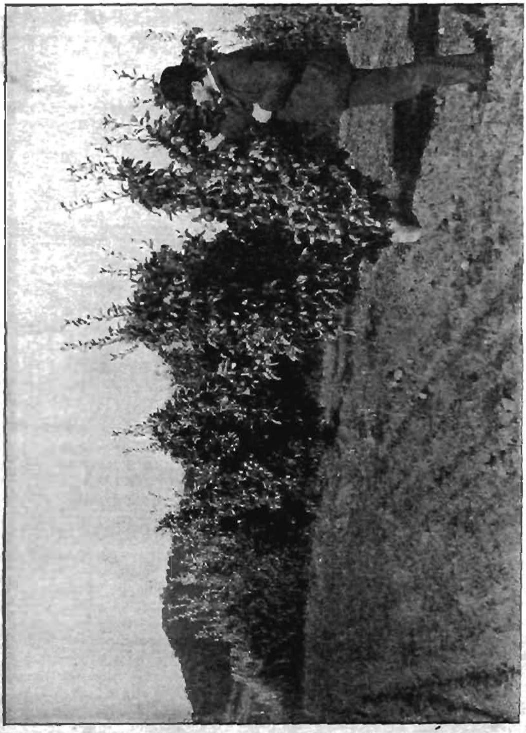


FIG. 112.
TYPES OF ORCHARD TREES, BAGDAD, TASMANIA.

a limited number of buds, as per Rule 4 in theoretical principles. The popular method of raising it quickly by retaining each year's extension in full will not, in the majority of instances, give the stability essential to a main arm. The vigorous winter pruning found necessary in forming a

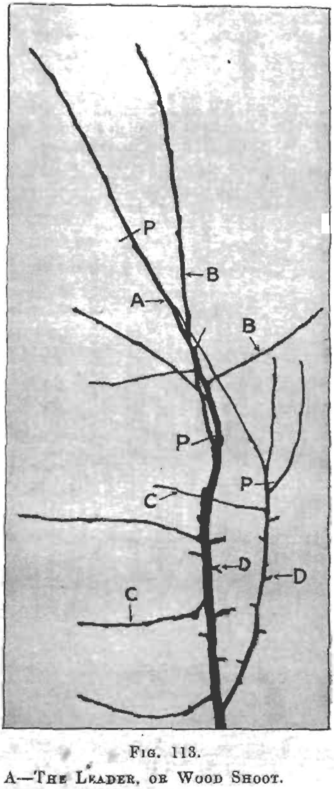


FIG. 113.

A—THE LEADER, OR WOOD SHOOT.
B—LEAF TWIGS (TO BE REMOVED).
C—LEAF TWIGS (OF DESIRABLE FORM).
D—FRUIT AND LEAF SPURS.
P—POSITIONS FOR SUGGESTED PRUNINGS.

stout-limbed apple tree causes a great many strong shoots to start which are not required as leaders. To remove these entirely when fully grown appeals to one as being wasteful. To cut them back a little in winter only aggravates the evil by causing an increased number to appear during the following summer.

There are three methods of dealing with those growths (laterals) which cannot possibly be retained for leaders, and which at the same time are likely to extend to such a length as to cause overcrowding.

The *first* consists of pinching out the growing tip after it has developed about half a dozen good leaves. This is done in the spring or early

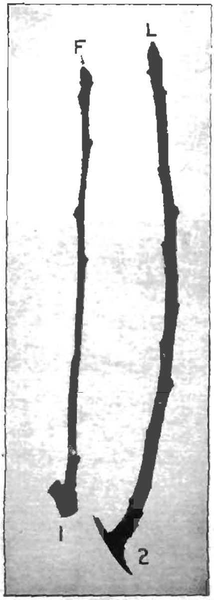


FIG. 114.

(1) THE FRUIT LATERAL (F FLOWER BUD).

(2) THE LEAF TWIG (L LEAF BUD).

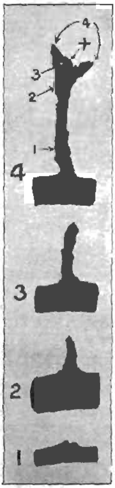


FIG. 115.

(1) LEAF BUD.

(2) LEAF SPUR.

(3) FRUIT SPUR.

(4) FRUIT SPUR WITH FOUR SEASONS' GROWTH (SHOWING LATERAL SUBDIVISIONS AFTER FIRST FLOWERING AT X).

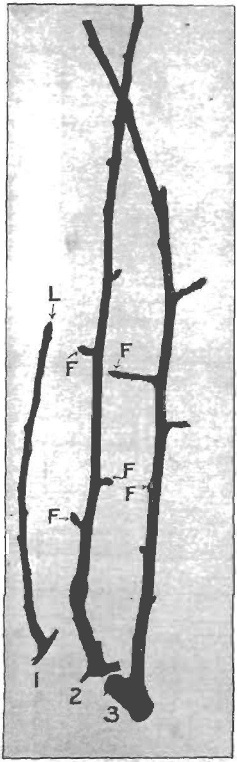


FIG. 116.

(1) LEAF TWIG, FIRST YEAR (L LEAF BUD).

(2) (3) LEAF TWIGS A YEAR OLDER, SHOWING DEVELOPMENT OF FRUIT SPURS AT F.

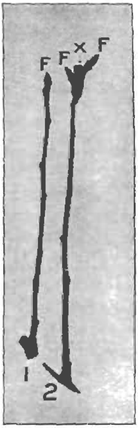


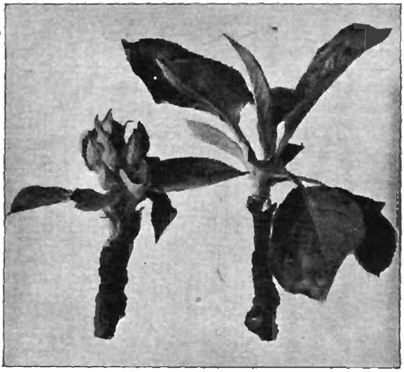
FIG. 117.

(1) FRUIT LATERAL, FIRST YEAR (F FLOWER BUD).

(2) FRUIT LATERAL, SECOND YEAR (F FLOWER BUDS), BLOSSOMED PREVIOUSLY AT X.

summer and must, in most instances, be repeated again upon the subsequent growths which invariably arise from the shoot when it recovers from the temporary stopping. This is a time-consuming work, but excellent results in the direction of forming short spurs have been obtained by its application to varieties which produce long thin laterals, such as Jonathan and Rome Beauty. (See 2, Fig. 122).

The second method is to wait until the lateral has reached almost full length (say at mid-summer), then it is cut off from four to six leaves above its base. The guiding factor in this operation is the moisture in the soil,



(1) (2)

FIG. 118.

(1) BEHAVIOUR OF FLOWER BUD IN SPRING.

(2) BEHAVIOUR OF LEAF BUD IN SPRING.

(1) (2)

FIG. 119.

(1) TO START THE DORMANT BUD S THE UPPER SHOOT IS PINCHED OFF AT P.

(2) THE RESULT

because if enough still remains, or a fresh supply is given immediately after by rain showers or irrigation, the pruned shoot will break into renewed growth. This may not prove the work to be altogether nugatory, as whilst one or two buds may extend into uselessly long growths, one or more of the others near to the base of the stump often progress into that short wood-spur stage which is the object sought by the operator. (See Fig. 123.)

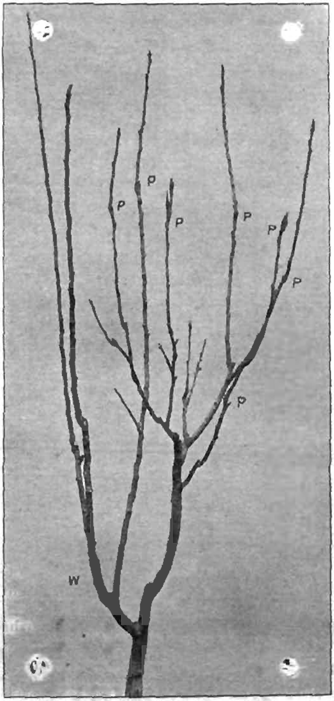


FIG. 120.

THE LEADERS WERE PINCHED AT P WHEN GROWING TO ENABLE W TO OVERTAKE THEM.

The third method consists of partially breaking the lateral through at about the same distance from its base as described above. The portion beyond the fracture is allowed to hang down with its leaves attached for the remainder of the summer, but is pruned away in the following winter. To cause the development of the short leaf spurs from buds upon the basal segment this operation must be done when the sap has almost, but not quite, ceased to flow. (See 1, Fig. 122 and Fig. 124). The chief disadvantage attached to this method is the over shading of the lower portions of the tree by the dense foliage of the hanging partially-fractured laterals. (See Fig. 129).

At the best the starting of the buds upon the basal portion of the lateral into a very restricted form of activity, so as to cause them to develop sooner into fruit spurs which shall be close up to the stiff parent limb, is all that can be hoped for from these two operations as far as the laterals under treatment are concerned. There are so many influences operating against the accomplishment of this object that, with the exception of those leterals for which there is not room, viz., those arising between the framework, limbs, or intruding into the centre too far, or growing from the high slender portions of the leaders, the changing of the nature of the shoots by such artifices presents a problem of considerable uncertainty. One thing, however, is sure, that the removal of trashy crowding twigs admits abundant sunlight and air to the spurs which form naturally from buds whose vigor has been restrained by the growths of new shoots more advantageously situated. This light and air keeps these natural spurs sufficiently healthy to enable them to develop their terminal buds up to the flower-forming stage at an earlier period than if they had to wait for the crowded laterals to open out by means of their own weighty and extended development.

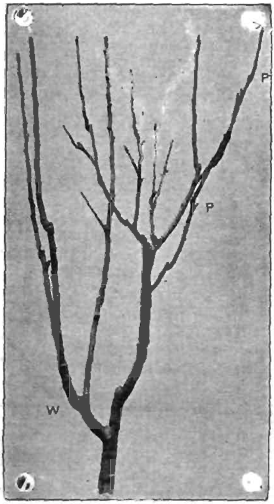
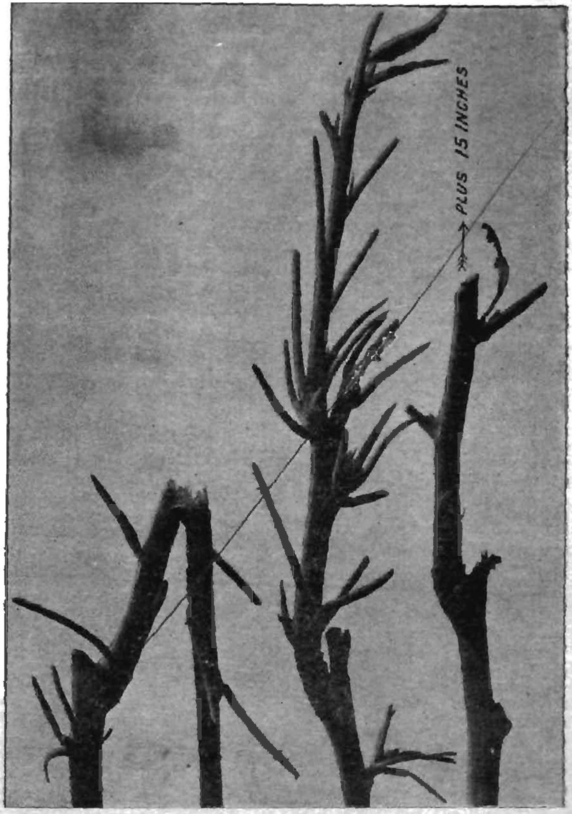


FIG. 121.

THE NEXT WINTER PRUNING OF TREE IN PREVIOUS PLATE.

When the summer's growth has just about reached completion the best wood shoot, or at most two, upon each leader of last year should be selected to continue the framework; and any others, if not previously manipulated as heretofore described, may be absolutely suppressed. This is illustrated in Figs. 125, 126, 127, 130.



(1) (2) (3)

FIG. 122.

(1)—SHOOT PARTIALLY FRACTURED. (2)—SHOOT FRACTURED AND PINCHED LATER.
(3)—SHOOT FRACTURED TOO EARLY.

[*All Leaves Removed for Illustration Purposes.*]

The Renovation of Old Trees.

Under favorable conditions respecting the climate and soil, and in the absence of American woolly blight, the apple tree is tolerably easy to renovate. If the object is simply to thin declining branches out of the top, or reduce the height of the tree, care should be taken to make all cuts immediately above a side branch. A cut to a blind stub or an old fruit spur rarely proves effective in the direction of giving rise to good leaders.

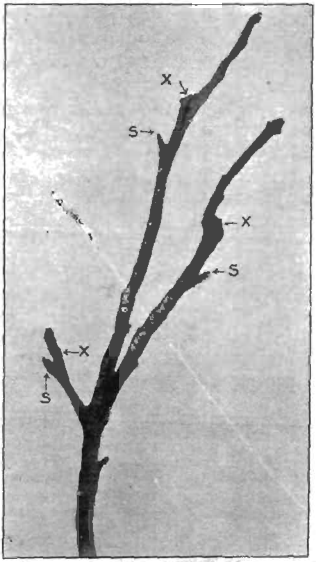


FIG. 123.

RESULTS OF SHORTENING (SPURRING) BACK LATERALS AT X.
(S ARTIFICIALLY INDUCED SPURS).

Many unthrifty and neglected trees which are now a mass of overcrowded weakly leaders and laterals may be brought back to a thriving and profitable condition by judiciously thinning out and spacing the leaders and at the same time shortening in and thinning off some of the spurs and laterals upon those retained, so that an ample supply of light and air is guaranteed to every one. This treatment is suggested in the branches shown in Figs. 131 and 132.

Probably the best method of reforming and refurnishing with fruiting wood old trees which are sound in skin and limb is to cut out large vertical branches from the centre, if such exist, and to shorten in the more horizontal ones. Thus exposed to the light the sap will operate with great vigor upon any dormant buds in the bark on the upper sides of such limbs, causing a great number to start into rank growth. From these, by judicious pruning in winter and summer, the bare limbs are gradually reclothed in fruit-bearing wood. The pruning consists of reducing the number of strong sappy shoots in summer by rubbing off

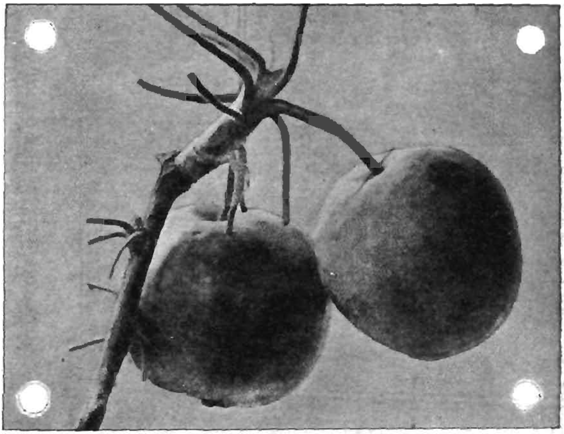


Fig. 124.

Unusual Results on a Fractured Shoot—It Fruits During the next Summer.

some, more particularly those starting upon the upper sides of the limbs. In winter those remaining should be pruned to direct their growth towards a broadly oblique position.

If it is deemed desirable to substitute a better variety for a healthy old top of inferior kind the conditions must be highly favorable to permit the whole of the top being removed at once. In rather hot localities the most central branches emerging from the highest part of the stem should be cut off and regrafted first. Twelve months later the remainder should be treated similarly, if more grafts are needed.

Where everything is favorable, however, old trees may be cut to a low stump, and, providing no sun-scalding occurs, the grafts may in time completely callus over the wounds made by the operation.

In all cases where the trees are cut back to bare stumps it is wise to shelter them by wrapping straw, grass, or bagging over the bark, or by putting on a thick coating of limewash. The wounds, when made and left above ground, should also be carefully cleaned with a sharp knife, dressed with

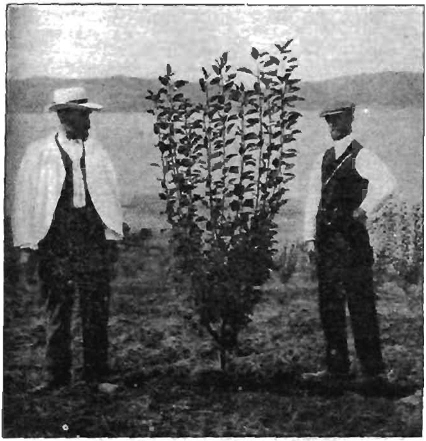


FIG. 125.

A THREE-YEAR OLD APPLE TREE WITH LATERALS VERY SEVERELY SUMMER PRUNED.

[*Tamar River, Tasmania.*]

thick paint, and covered over with a bagging hood for the first season, until the foliage of the grafts shades them sufficiently. Very low stumps may be encased in some vessel, such as an old tin, with bottom and top removed, and earth filled in until the stump and its scions are quite covered. Too much care cannot be given to the rapid healing of these large wounds, as the permanent success of the renovating process depends

upon its successful accomplishment. To attain this end more scions than are required to frame the tree may be inserted. By having them growing fairly closely together around the margin of the wound during the first couple of seasons the bark is kept active, and the healing thereby

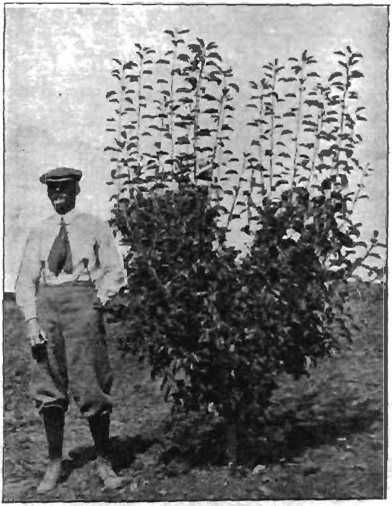


FIG. 126.

A SKILFULLY PRUNED JONATHAN APPLE TREE, FOUR YEARS OLD.

[*A Tamar River (Tasmania) model.*]

facilitated. A form of bark graft in which a "strap" of the scion passes over the cut section of the stock before being inserted beneath the bark on the opposite side to where the erect bud-bearing portion of the scion is inserted, has been used with conspicuous success by some of our most experienced growers in securing a rapid healing over of the wounded stocks.

It is seldom wise to bud upon the young shoots which emerge from the stumps of an old apple tree. They, as a rule, are unfavorably situated for assisting in healing over the old wounds. This defect is probably of secondary consideration compared to the injurious check the tree sustains

FIG. 127.

STURMER PIPPIN APPLE TREE, FOUR YEARS PLANTED, SHOWING THE POSITION OF THE FIRST FRUITS UNDER A SYSTEM OF RATIONAL PRUNING.

[*Tamar River, Tasmania.*]

when the tops of these young shoots are cut away to start the inserted buds. This second restriction often appears to inflict greater injury than the primary removal of the top, and not infrequently kills the tree.

FIG. 128.

A DENSELY GROWN APPLE TREE.

[*Dunn's Seedling.*]

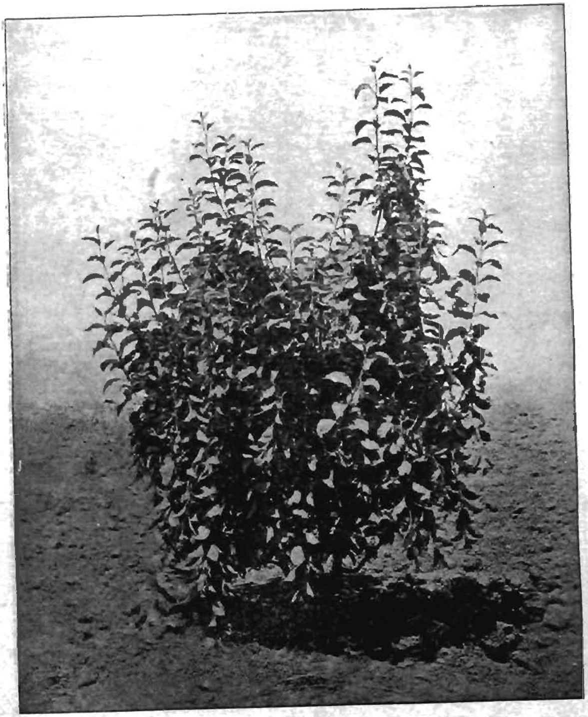


Fig. 129.

Tree in Fig. 128, with Partially Fractured Laterals Hanging.

Fig. 130.

Tree in Fig. 128, with Upper Portions of the Surplus Laterals (Leaf Twigs) Removed.

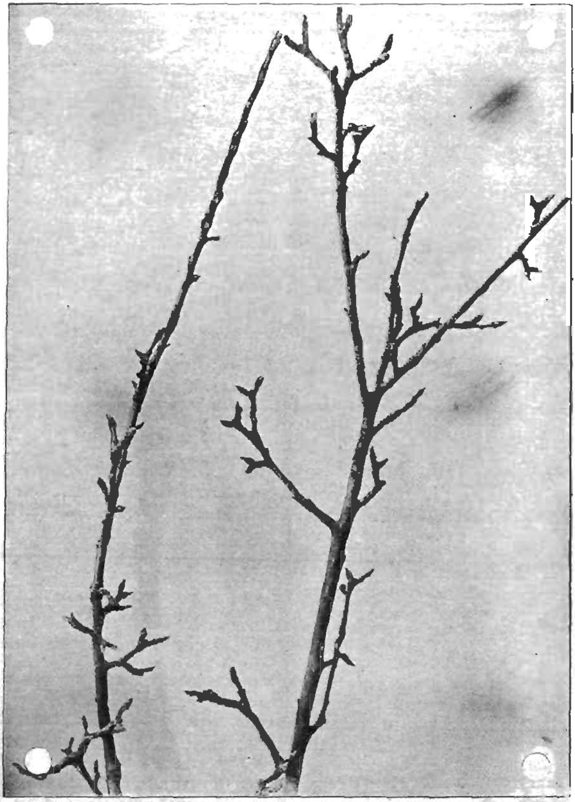


FIG. 131.

OLD APPLE SHOOTS WITH EXTENDED LATERALS AND SPURS.

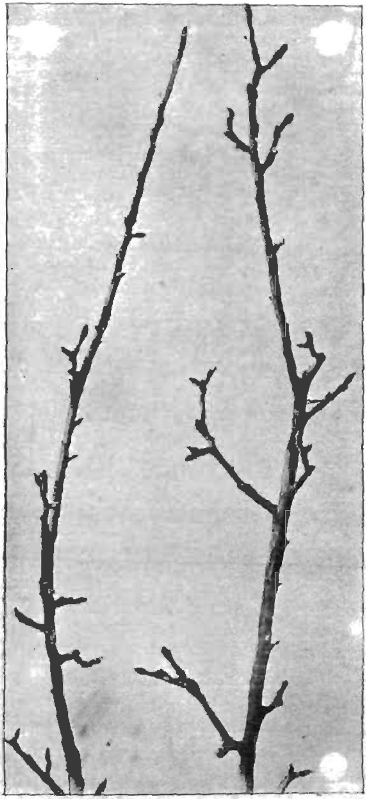


FIG. 132.

PRUNING SUGGESTED FOR SHOOTS IN FIG. 131.

THE PEAR.

With the exceptions supplied by a few weakly-growing varieties, the pear, under favorable conditions, makes more erect and rapid growth than the apple. The wood is somewhat brittle, and in consequence of their tendency to break off when subjected to the strain of fruit-bearing, the branches require to be set in stoutly.

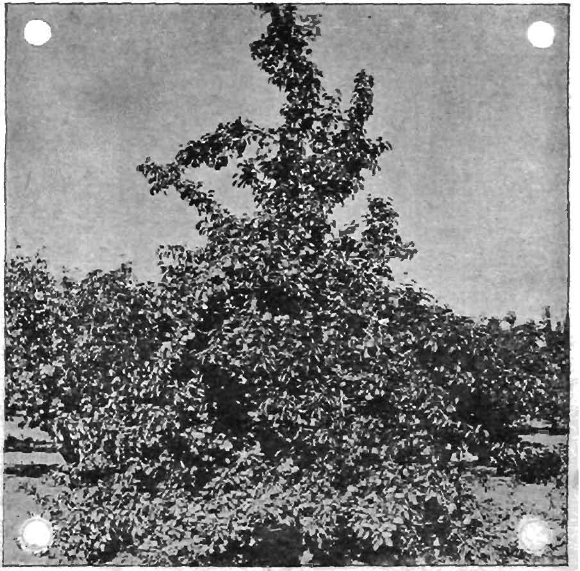


FIG. 133.

THE PEAR TREE NATURALLY ASSUMES A CONICAL SHAPE.

The form naturally taken by most of the varieties is that assumed by coniferous trees. This is broad at the base and tapering towards the top. (See Fig. 133). It is sometimes called a pyramid, but is more correctly described as a cone. To train the pear as an inverted cone the pruner must, for a number of years, constantly fight against the tendency of the tree to revert to this natural shape.

We will here deal with the inverted cone shape only. To successfully establish the pear upon these lines the stem should be set low. The main arms arising from the stem must be cut back short at their first winter's pruning. The direction they take should be such as will give

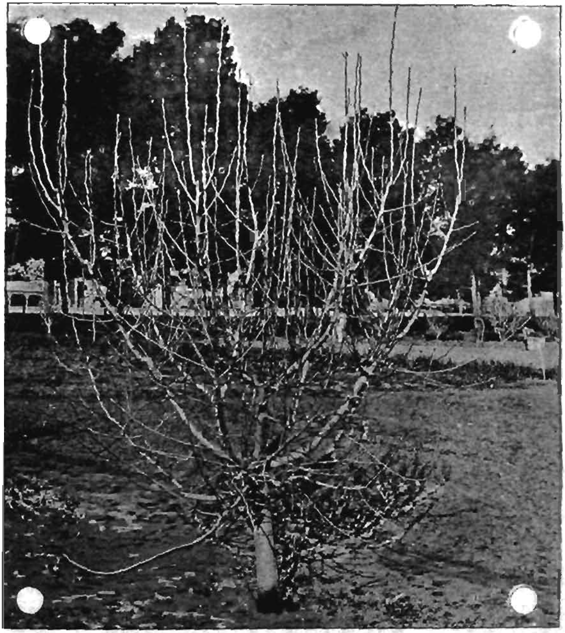


Fig. 134.

Pear Tree (Gansell's Bergamot) Trained as an Inverted Cone, showing Lower Fringe of Laterals.

the tree a broad base (see *Figs.* 135 *and* 136). This will be best accomplished by cutting the arms above buds situated on their outer sides, and which at the same time point away at equal angles, and leaving temporarily a long piece of internode above the top bud on each shoot. The secondary arms arising therefrom should be also cut back fairly short at the next

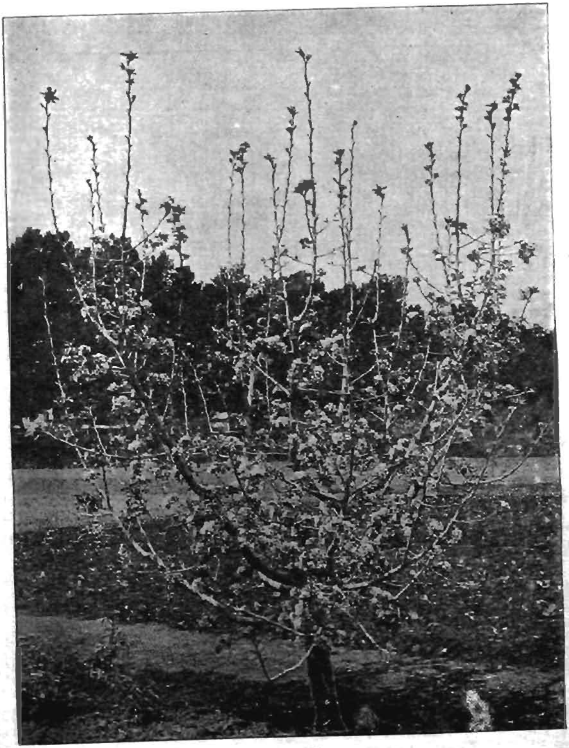


FIG. 135.

THE PREVIOUS TREE IN BLOOM A FEW MONTHS LATER.

winter's pruning. Their course should be maintained by selecting such buds to continue the extension as point in the desired direction, and by making the sections high above such buds, as previously indicated. At this stage the stub or piece of internode left last winter should be removed cleanly, to permit the proper healing of the wound. An alternative method for making a broad base is to permit a limb to grow up in the centre of the tree for a couple of years and then to suppress it completely. If strong leading shoots arise from the secondary arms they may be allowed to retain a considerably increased length at

Fig. 136.

Pear Tree (Glou Morceau) being trained with a Broad Base.

their first winter pruning, but the pruner should never forget the stoutness essential to their future wellbeing. By this time a dozen or so of leaders, representing the required complement, may be usually secured. Where a pear tree grows vigorously after about the fifth year, the leaders may be allowed to go unshortened for a season, as this treatment appears to set back the sap into the laterals and encourage the formation of spurs throughout the whole tree.

While thus framing the permanent parts of the tree, care must be taken that no wood shoots other than those required as leaders be permitted to unduly extend from their parent branch. Abundance of shoots will be at hand, but all others than leaders must be studied, and, where necessary,

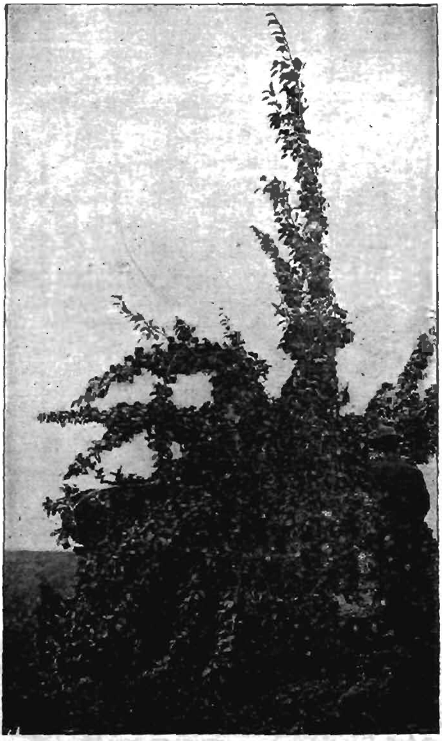


FIG. 137.

WHEN THE LEADERS OF THE PEAR TREE ASCEND TOO RAPIDLY THIS OCCURS.

Fig. 138.

Pear Tree (L'Inconnue) of
Natural Form.

dealt with in a manner likely to induce a stunting effect upon them. *The* frequent subdivision of the spurs laterally makes the wide spacing of the permanent limbs a less important item than even upon the apple. The permanent limbs of a well-trained pear tree in ascending undoubtedly should attain stoutness in proportion to their length. Every limb being thus kept in a comparatively fixed position, with light reaching all around it, scarcely a bud should fail to be utilised. All those, other than

FIG. 139.

SUGGESTED START TO REFORM THE PREVIOUS TREE.

[NOTE.—*Central Leaders retained temporarily to broaden the base.*]

the few selected for leaders each season should be considered as laterals, to be ultimately checked off into spurs by processes explained later. Such a tree would carry its oldest and most-developed spurs upon its stoutest parts at the base. Instead of the top portions carrying the first fruits they would only bear fruits as the spurs upon them matured flower buds. This, under a proper method, allows the bearing portion to be several seasons old before it sets fruits, during which time each limb acquires stability. The result of a contrary course of training is illustrated in Fig. 137.

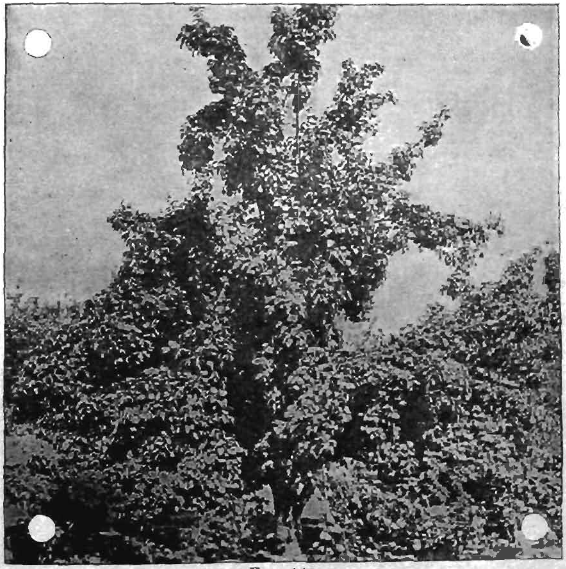


FIG. 140.

HEAVILY LADEN L'INCONNUE PEAR TREE FOLLOWING ITS NATURAL FORM.

In Fig. 134, Gansell's Bergamot tree, about seven years old, is shown, trained somewhat upon this open inverted cone system. Having acquired a strong base, this tree is now being allowed to run lightly pruned, whilst a considerable number of the shoots in the centre have been removed and the laterals thinned out, those laterals which form an outer fringe to

the permanent limbs have been retained. In Fig. 135 this tree, as it appeared in the spring time, about 15 months later, is shown. The achievement of the pruner in distributing the fruiting wood over the stoutest portion of the tree is illustrated by the presence of most of the

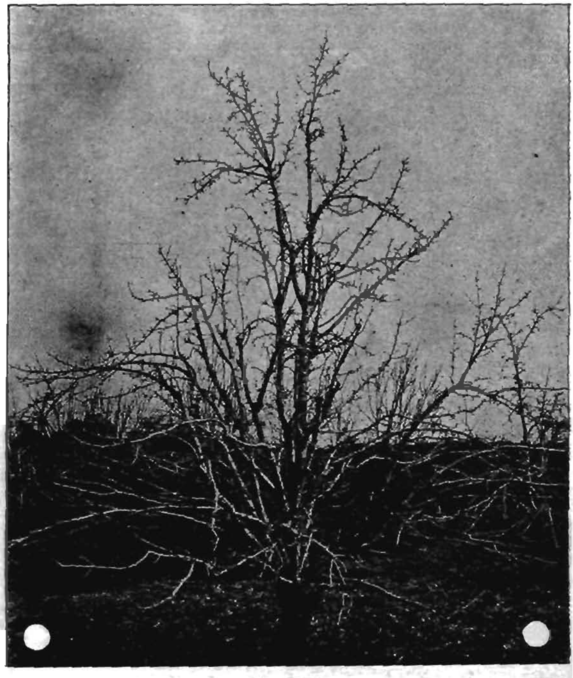


FIG. 141.

THE DISORDERED CONDITION OF THE PREVIOUS TREE IS SEEN WHEN IT IS RELIEVED OF FRUIT AND FOLIAGE.

flower buds upon the lower parts of its permanent limbs. The fruits set upon this tree as regularly as the blossoms are distributed, and an excellent crop was harvested in the following autumn. The leaf growth upon the spurs was also so profuse that in seeking for evidences of codlin moth the

FIG. 142.
L'INCONNUE PEAR TREE (16 YEARS OLD), TRAINED ON METHODICAL LINES.

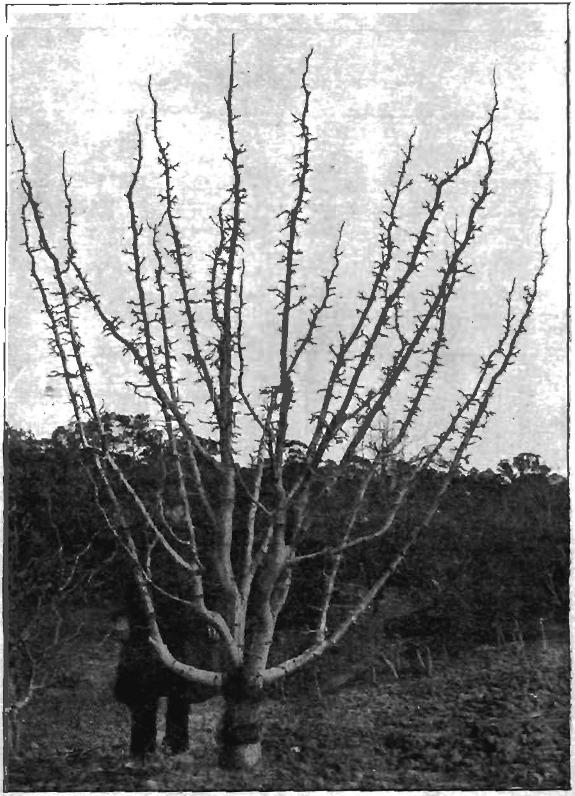


Fig. 143.

The Previous Tree (L'Inconnue) when bare of Foliage and Fruit.

gardener found the density of the foliage a considerable drawback to the rapid examination of the fruits. In consequence, the reduction of the spurs and laterals would soon be entered upon, as a characteristic of this variety is to form spurs very freely, both upon the laterals and permanent arms.

FIG. 144.

PEAR TREE (BEURRE CLAIRGEAU).

[*A Broad-based sturdy specimen.*]

Fig. 138 shows a young L'Inconnue pear tree in a somewhat neglected condition. It will be noticed how the fruit spurs have begun to form near the top of each leader. The density of the leaders does not permit of a proper admission of light or development of spur wood. Fig. 139 shows this tree pruned with a view to training it upon the lines of the

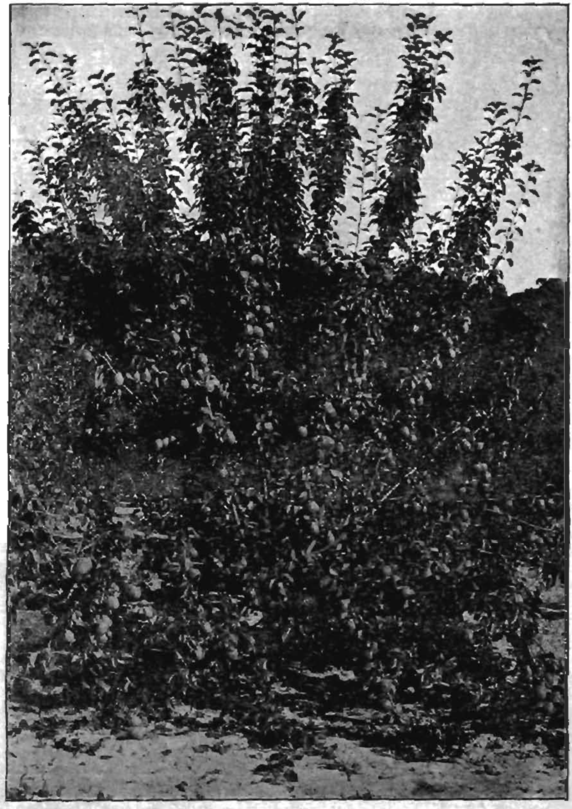


FIG. 145.

PEAR TREE (KEIFFER'S HYBRID) EIGHT YEARS OLD, VERY PRODUCTIVE, BUT IN NEED OF ATTENTION.

tree of the same variety drawn in Fig. 143. Some of the leaders have been thinned out; and those it is intended to permanently retain have been cut back severely to ensure a more sturdy condition. The leaders will not be permitted to ascend so rapidly in future. In order to carry

Fig. 146.

Pear Tree (Williams' Bon Chretien) before Pruning.

a few fruits, and to check as far as possible the tendency to send up a dense thicket of shoots in the centre, several leading limbs have been permitted to remain for the present. These should, however, be removed or shortened back to side branches a season or two later, otherwise they will dominate and dwarf those forming the outer framework of the tree. *What would become of this tree if left entirely unpruned can be imagined* from a study of one of the same variety shown in Fig. 140. This

FIG. 147.

THE PREVIOUS TREE PRUNED, SHOWING ITS ERECT STIFF CORDON-LIKE LEADERS CLAD IN SHORT SPURS.

photograph was taken in the summer, when the tree was a sprawling mass of leaves and pears. In the following winter the photograph shown in Fig. 141 was taken, showing the damaging effects of bearing upon wood of a slender character. The tree is full of broken upper limbs and branches bending over lower ones, to their great detriment; the whole body of the tree is a tangled mass of laterals and spurs. To bring it back to a better condition the leaders should be reduced in number and the laterals and spurs upon them thinned out and shortened, as indicated in Fig. 163. The reader is asked to contrast this disorganised tree with one of the same variety in Figs. 142 and 143.

Fig. 144 represents a tree of Beurre Clairgeau, grown with a broad base. If this variety is permitted to ascend in its natural erect form the loss of fruit from the action of the wind is always very great. It will be seen that the fruits on this tree are clustered in large numbers upon spurs emerging from lower portions of the stout arms which cannot sway in the breeze. This sort clothes itself naturally in an abundance of short spurs, long laterals being neither necessary nor desirable for its well-being, excepting, perhaps, in the first few years of its lifetime: and the tree of Garber's hybrid, Fig. 137, presents an example of the results of slightly over-stepping the bounds of prudence in allowing the leaders to ascend uncut. Borne to the ground by an overwhelming crop of fruit near to their terminals, many of its leaders will not rise again beyond a horizontal position: and the difficulties of tillage will be increased, if no defect of greater importance ensues.

Fig. 145 conveys a capital idea of a heavily laden eight-year old tree of Keiffer's hybrid. This variety has naturally an erect habit of the most pronounced and vigorous type. Unless the leaders are permitted to ascend rapidly and the laterals to grow with a similar luxuriance, the fruiting age of the tree may be postponed almost indefinitely. This specimen has been shaped out broadly and strongly at the base by pruning the leaders hard for several winters after it was set out.

Now, the unduly long laterals may be shortened back to stiffer dimensions, while at the same time the leaders should be reduced in number, lightened of laterals at the top, and possibly curtailed in length.

The William's Bon Chretien pear tree, Fig. 146, is an older tree, and has long since reached the cropping stage. It will be seen that its laterals (leaf twigs and fruit laterals) are short; the yearly leading shoots are also very restricted, whilst the cordon-like limbs of which the framework is composed are clothed very consistently in spurs. Fig. 147 indicates the short-spurred winter pruning advocated for this type of tree.

In strong contrast with many of the foregoing is the 16-year old L'Inconnue tree, shown in Figs. 142 and 143. This tree was not brought to such a stage of good form and productiveness hastily, even although the variety naturally lends itself to the close formation of spurs. This specimen represents an example in the economy of fruit production. There is upon it no crowded shoot, neither is there an unprofitable one. Each permanent branch occupies the space set aside for it, and it fills that space sufficiently with fruit-bearing wood (spurs). Excepting upon the lowest part of the framework there is no unoccupied space, neither can superfluous limbs be found upon it. The chief, though not serious, defect in its design has arisen from faulty treatment applied during the first year or two after the tree was planted.

The Annual Wood and its Treatment.

- The wood shoot or leader A, Fig. 148.
- Leaf twig, (1), Fig. 149; (1), Fig. 150.
- Fruit lateral (2), Fig. 149; (2), Fig. 150.
- Leaf spur (2), Fig. 151; (2), Fig. 152.
- Fruit spur (3), (4), Fig. 151; (1), Fig. 152.

The pruning of the LEADER has been dealt with in describing the building up of the framework of the tree. This may be summed up briefly by repeating that its use is to direct and maintain the form of the tree as well as control its vegetative activities. It is therefore pruned short for several seasons after the tree is set out into the orchard, to give a stoutness to the main and secondary arms. After this, greater lengths are permitted to remain at each winter's pruning. When the fruiting habit has been established for a number of years and the general vigor of the tree begins to decline, it becomes necessary to again apply short pruning to the leaders to stimulate the sluggish flow of sap in roots and branches.

Sometimes the bud which is situate at the best height and position on a leader to give rise to another shoot which shall continue that limb in a desired direction is a flower bud. In such a case the flower bud may be rubbed off, and one of the leaf buds attendant upon it, which is located in the bark though not prominently visible, will, owing to its superior position, usually take up the leadership. Any wood shoot found upon the tree at the winter pruning season, if not required as a leader, is suppressed to the parent branch.

THE LEAF TWIG, when not unduly long—say, not exceeding more than 1½ft. from the outer face of a stiff limb the first year—is left

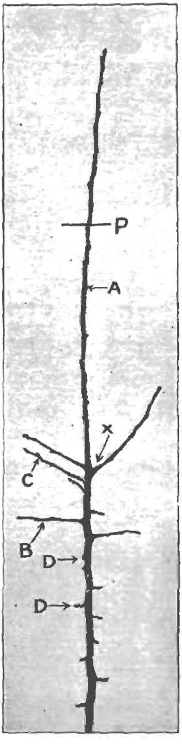


FIG. 148.

A—THE WOOD SHOOT OR LEADER FROM X.

B—FRUIT LATERAL.

C—LEAF TWIG.

D—FRUIT SPURS.

[*Suggested Pruning at* P.]

unpruned in winter until such time as it becomes clothed in spurs. It may then be shortened back gradually over a series of years, as indicated in (1) Fig. 153, beginning the first season at a position such as that noted alongside of 3, the second at 2, and so on as the resulting effects suggest. Leaf twigs which grow in an overcrowded condition should be thinned out, but such work is best performed in summer. Those projecting into the centre of the tree, and others growing between the upright permanent arms, are also best stunted in summer by *pinching, fracturing, or shortening. Those arising from the upper and slender portions of leading shoots should be suppressed.*

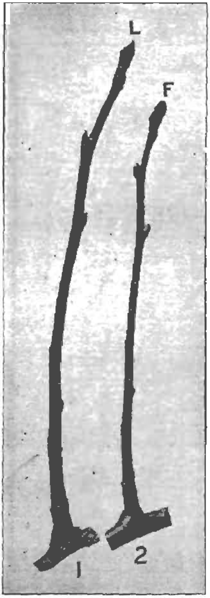


Fig. 149.

(1) Leaf Twig (L Leaf Bud).

(2) Fruit Lateral (F Flower Bud).

[Note. — *Occasionally other Flower Buds are developed on the sides of Fruit Laterals.*]

The Fruit Lateral is treated in a precisely similar manner to the leaf twig, but when necessary to thin out either of these types of shoot, all other things being equal, the fruit lateral should, for reasons which are obvious, be retained uncut.

The Leaf Spur represents the first advance made by a leaf bud which is only sparingly supplied with sap. It is never pruned individually, but, in reducing lengthy laterals, some of these spurs may be indirectly pruned away.

The Fruit Spur, in its earlier years of fruition, is not pruned in a direct manner, but as it becomes much divided after a long succession of bloomings or fruitings, its branches become attenuated and lack vigor. The necessity then arises to reduce the number of its subdivisions and to cause an infusion of fresh energy into those nearer its base, as indicated in Figs. 155 and 156. The somewhat alternating habit of fruit bearing assumed by the divisions of a well-advanced fruit spur of the pear throws light on the life processes contained in them which may in the future be so directed and utilised that a greater regularity of cropping may become an assured result. Whether the pruning away of certain spur growths, or only the systematic removal of the fruits found upon them in early summer would prove the most advantageous in this respect, remains yet to be proved. As with the similar shoot upon the

apple, the fruit spur of the pear, when the flowering stage is reached, sends out lateral extensions as seen in Fig. 154. The behaviour of the terminal buds *upon the spurs* (3) *and* (2), *Fig.* 151, in spring is seen in Fig. 152.

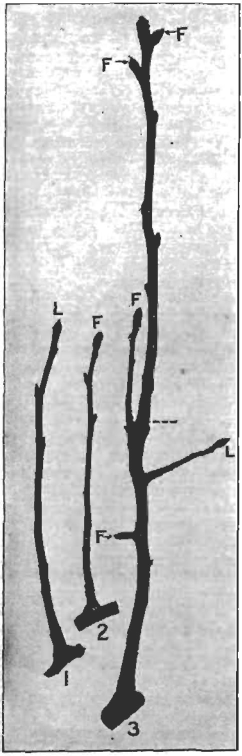


FIG. 150.

(1) LEAF TWIG.
(2) FRUIT TWIG.
(3) LEAF TWIG CARRYING TWO SEASONS' GROWTH. F—FLOWER BUDS. L—LEAF BUDS.

[*Suggested Pruning at dotted line.*]

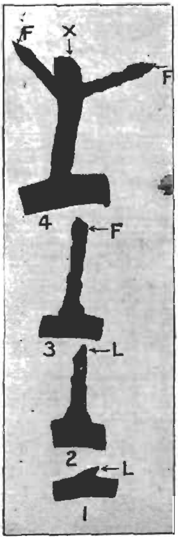


FIG. 151.

(1) LEAF BUD L.
(2) LEAF SPUR (L LEAF BUD).
(3) FRUIT SPUR (F FLOWER BUD).
(4) OLDER FRUIT SPUR (SHOWING LATERAL BRANCHES AFTER FLOWERING AT X).

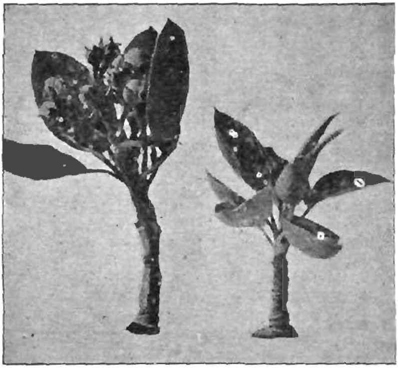
Summer Treatment.

The summer treatment to be applied to the pear coincides in every important particular with that suggested for the apple. This may be briefly stated as follows:—

a. Fracturing.

b. Pinching.

c. Shortening lateral growths, combined with disbudding the terminals of dominant leading shoots on young trees and suppressing surplus leaders in late summer on vigorous trees, during the earlier years when they are approaching full fruition.



(1) (2)

FIG. 152.

(1) HOW (3) IN FIG. 151 WOULD APPEAR NEXT SPRING.

(2) HOW (2) IN FIG. 151 WOULD BEHAVE NEXT SPRING.

[NOTE.—*Out of the Flower Bud on the apex* A CLUSTER *of Blossoms arises.*]

Fig. 157 is drawn from a photograph of the upper portions of two leading shoots cut from a young pear tree which displays considerable vigor of growth. At Fig. 158 (1) shows the application of the partial fracture to the surplus leaf twigs upon the left-hand leader in the preceding illustration; whilst (2) indicates the appearance of the right-hand shoot after such lateral growths have been stopped or pinched above the first few good leaves which are developed upon each one.

Fig. 159 shows the shortening, or so-called "spurring back," of the lateral growths arising from such leaders as applied after midsummer.

The seven-year old tree of Easter Beurre shown in Fig. 160, exhibits a density of leaders and laterals to which the suggested mode of thinning has been rationally applied in Fig. 161. It will be seen that, with the exception of shortening a few of the unduly extended laterals on the outer surface and some overcrowded ones in the centre of this tree, the summer pruning has consisted of spacing the leaders only.

The Renovation of Old Trees.

The pear is particularly tenacious of life, and responds to renovating treatment well when growing under anything like fair conditions. There are many pear trees which require rejuvenating without the need for regrafting them to fresh varieties. The tops have become a tangled mass of laterals or spurs of a multi-branched and impoverished character. In such cases the top leaders should be thinned out, by removing any that may be out of place or molesting others considered more valuable. The laterals upon those retained should be cut back, as illustrated in Fig. 153 and the spurs thinned off, those remaining being duly shortened back to their parent shoots. All branches which bend and overlap others below ought to be removed, or shortened to such a length as will not continue the disability under which the lower ones labored or dwindled.

In Fig. 162 such a leading shoot as retained is given, and Fig. 163 shows the pruning suggested for it. Figs. 155 and 156 are two types of old many-branched spurs found on neglected pear trees. The pruning suggested for each is depicted with them. The treatment might have been much more drastic, but the

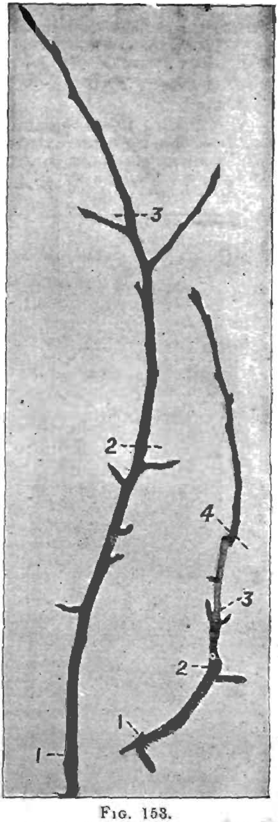


FIG. 153.
LEAF TWIGS AND THEIR SUBSEQUENT DEVELOPMENTS OVER SEVERAL YEARS.
[*Suggested shortening back to begin at 3 and 4 respectively.*]

fruit for the coming season has been considered. Next winter these could be further reduced, and so on until an even state of vigor is infused throughout the tree.

When it is deemed desirable to cut back the old tree and form a top of some other variety the process is easy. If the main arms are low down upon a suitable trunk, the grafts could be inserted into them. If, however, these are not suitably located, the tree may be cut back to a short stump and grafts inserted around it, as described for the apple. The pear is less liable to sun-scald than the apple under similar circumstances. To avoid a crop of suckers a number of shoots should be allowed to grow from the old stem *below the grafts*, as these shade the stem and help to establish an equilibrium betwixt root and top once more. They can be removed the following year at any convenient time. The growths from the grafts often extend so rapidly that by no other cause than their own weight they twist and hang down. This may be averted by an occasional nipping-out of the growing points, which will steady the growth and result in increased stability of fibre at an early stage. Budding on to side shoots from the old stock can be practised more successfully than with the apple, and if the former, *i.e.*, the grafts, fail, the loss of a season may be obviated by resorting to it. Old trees of an unfruitful habit, though of desirable kind, are seldom met. When such occur the ringing of the stem, by taking out completely a circle of bark not more than ½in. wide late in winter, will frequently produce the desired effect. In an area of uncertain rainfall this method is to be preferred before any system of root-pruning.

FIG. 154.

FRUIT SPUR SHOWING AT B B, WHERE ITS LATERAL EXTENSIONS ARISE.

FIG. 155.

THE UPPER DRAWING SHOWS AN OLD EXTENDED FRUIT SPUR, AND SUGGESTIONS FOR RE-INVIGORATING IT ARE GIVEN IN THE LOWER ONE.

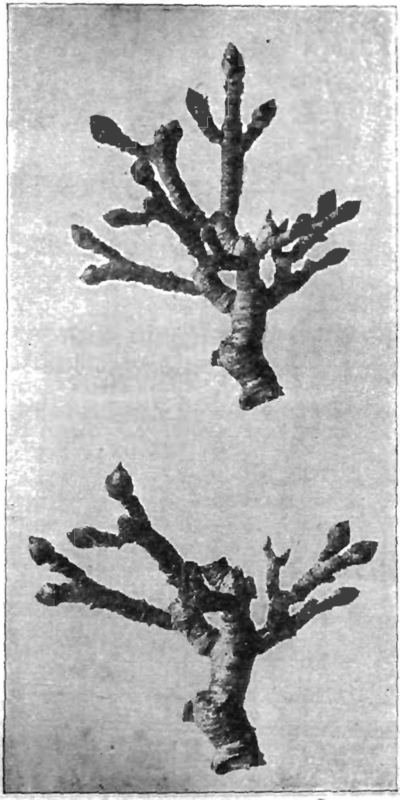


Fig. 156.

A much-divided Fruit Spur and suggested Renovation of same.

(1) (2)

Fig. 157.

Two Leading Shoots on Young Pear Tree before Summer Pruning.

(1) (2)

Fig. 158.

The Previous Shoots after Summer Pruning.

(1) Laterals partially fractured.

(2) Laterals pinched back at intervals.

FIG. 159.

LEADING SHOOT WITH ITS LONGEST LATERALS "SPURRED" (CUT) OFF A FEW BUDS ABOVE THEIR RESPECTIVE BASES AFTER MIDSUMMER.

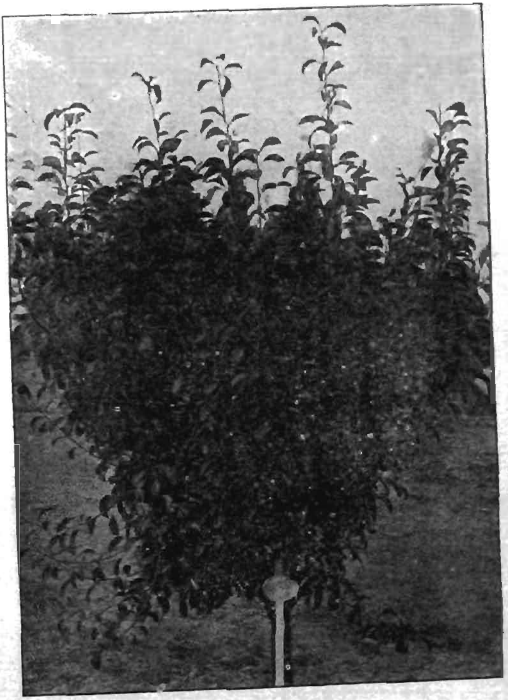


Fig. 160.

Pear (Easter Beurre) before Summer Pruning.

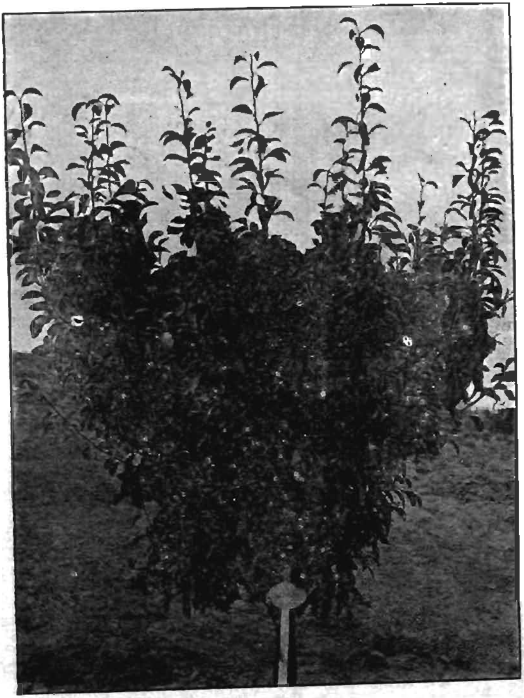


Fig. 161.

The Tree in Previous Figure after receiving a moderate Summer Pruning, *i.e.*, removing Surplus Leaders and shortening or suppressing Crowded Laterals.

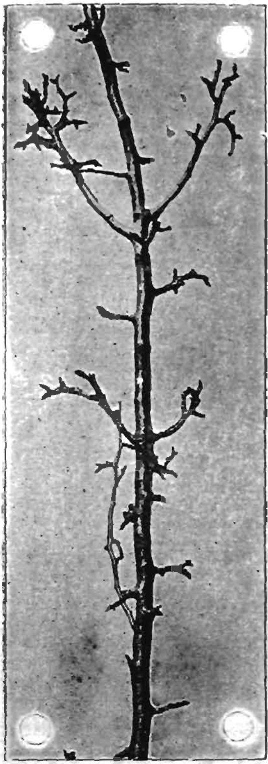


Fig. 162.

Leader from Old Tree showing Extended Laterals and Spurs.

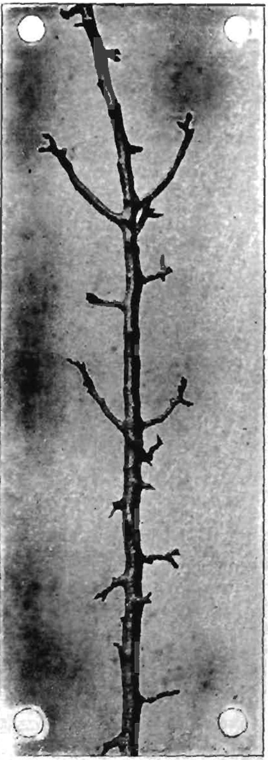


Fig 163.

Suggested Pruning of Fruiting Wood on the Leader in the Previous Plate.

THE QUINCE.

Under anything like favorable conditions, the quince is a very strong grower for a few seasons after being set out. This continues until the normal stature of the tree has been attained, or a fruiting habit developed. The rapidly-grown branches referred to are lithe and willowy. Unless set in stoutly by means of heavy pruning at the early stage of the tree's formation, this characteristic will cause it to assume a dense bushy habit during later years. The stem should be very short. The main and secondary arms must also be strongly set by hard pruning. The main arms should be carried out to an angle of about 45° from the main stem. The secondaries should continue in a like direction, and be carried from side buds upon the mains. If these are pruned short the trees will be provided with a strong broad base. The leading shoots arising from the secondary limbs should take their origin from buds situated almost upon the top of the secondary arms. These will turn the leaders towards a vertical direction. The angle thus formed will not only assist to check rankness of growth in future extensions, but give stability to the framework of the tree. The second hard winter pruning, which defines the main arms, will cause the rise of many other rank shoots. These, with the exception of those required for secondary arms, should be rubbed off in summer. The short pruning of the secondary arms at the third winter's operations will give a similar stimulus to many buds. All of those *on the outside* of the main and secondary arms should be retained wherever there is room for them; but none should be allowed to grow in such a manner as to fill the interior of the tree. The retention of these laterals, as already pointed out in respect to other trees, will have a tendency to stay the rank upward growth of the quince and turn it to a fruitful habit.

The fruits of the quince, as the tree is commonly grown, mainly hang out beyond the foliage, consequently in this climate they often sun-scald badly. In the extension of the tree beyond the secondary arms the shoots should be spaced to admit abundance of light around them. It should be recognized that there is a difference between diffused light and scorching sun glare. If light be admitted freely into the centre of the tree, short lateral growths are encouraged along the inner surfaces of the large limbs, thus preventing the occurrence of sun-scald. This is verified on peach and other trees when they are trained in this open manner.

When the normal size of the tree has been reached, there will still be a constant effort on the part of the natural bushy habit of the quince to reassert itself. This is exhibited in a profuse growth of water shoots arising in the centre from the old limbs. These must be suppressed without fail. The only value of such a rank shoot is found in using it as a replacer when a main branch fails. Unless some accident occurs, and a limb is broken, this is not likely to be called into practice. After the tree has developed a stout framework, hard pruning must not be practised. To maintain an equilibrium between fruit and wood production, usually indicated by general vitality, a certain amount of pruning is necessary; but this usually takes the form of thinning out closely placed shoots. Without a high standard of vitality being maintained, even on the frequently despised quince, the fruit deteriorates into acrid woodiness.

The tree shown in Fig. 164 is a most productive specimen. Grown in a garden situated on a hot plain, the fruits are, however, subject to sun-scalding, and a proportion each year is ruined thereby. It is typical of the average quince tree found in our orchards. Allowed to shape itself without interference, its twisted and crossed main arms are a study in overcrowded disorder. In later years it has been severely topped, and above its compound trunk may be seen numerous water shoots as an inevitable result.

FIG. 164.

QUINCE TREE OF MATURE AGE AS ORDINARILY GROWN.

Fig. 165 represents the same tree thinned out, both as regards the laterals and leading shoots. The terminal growths of the leaders have not been severely pruned, but all of the so-called water shoots have been removed.

The Annual Wood and Its Treatment.

The wood-shoot or leader.
The spur.
The lateral.

The pruning of the LEADER has been described in connection with the framing of the tree, and consists of cutting it either hard or lightly, as the general growth of the tree demands. After the tree is shaped and comes into bearing, the leading shoots should be kept fairly thinned out: but, unless the general vitality declines, hard cutting back is deprecated, as a cause of over production of bushy leaf growth.

The spur of the quince is a club-shaped branch having only poorly-developed leaf buds, or only indications of such at its nodes; but after blooming at its terminal points two buds usually arise on the edges of the abrupt end. One, or even both of these may give rise to a small shoot, or, more correctly, spur-branch, which may flower and set a fruit.

FIG. 165.

PRUNING SUGGESTED FOR THE QUINCE TREE IN PREVIOUS PLATE.

There is no recognised pruning applied to this spur in itself, but during *the course of thinning the laterals or leaders many spurs are suppressed.*

THE LATERAL on the quince is a light, tapering, curved, and often pendulous growth, which forms buds all along its length, excepting at the apex. Usually this portion dies back to a side bud situated below the terminal point of the shoot. These buds outwardly convey no idea of their immediate future development. They may give rise to other weak laterals or to spurs, each of which is topped by the characteristic single blossom which distinguishes the quince from its closely related pepins, the apple and pear. Those moderately strong ripe laterals occupying subordinate *positions for receiving sap usually give rise to fruiting spurs.* Weak spindly laterals may be thinned out, and stronger ones, considered capable of fruit bearing, may be shortened slightly only.

In Fig. 167 the operations suggested above have been applied to the shoots *shown in Fig. 166. The leaders may be noted on* (1) *Fig. 166* at F, and on (2) at the topmost Q. The short growths marked B are the spurs, whilst the lowest thin shoot on (2) is an annual lateral, and the next above it is a similar shoot a season older. To enable the reader to follow the fruiting habits of this somewhat neglected fruit tree the recent life *histories of the two shoots photographed in the same figure* are as follows:—

From the base of (1) to a slight bend below the fork F the wood is two seasons old. At intervals upon it a number of stiff spurs with a *truncated appearance* are located, and *two of these carry dried-up sun-*scalded fruits. Last season's addition begins where a slight bend is seen close above the topmost dried quince. Last year the three top buds left by the pruner upon the shoot (now represented by those carrying quinces and the thick base below F) sent out short shoots, each *terminating* in a bloom; two set fruits (now dried) and the third at the apex (probably owing to the excess of sap received in that position) did not. At the base of the flower scar, F, however, the three terminating shoots on (1) grew. The twigs B indicate by their twin buds that they may be expected to *bloom next season.* (2) *Carries wood one season older than the branch* just described. Two winters ago it was severed at the sharp stump seen in the angle opposite the second Q from the bottom. The next season it set quinces at the Q below and opposite to the severed point. At the same time several laterals were grown, and the vertical shoot ascended to the dead spike between the upper pair of stubs marked Q. Last summer, besides producing fruits at the two upper spots indicated by Q's, the topmost leading shoot extended as now seen. Short spur-like growths were sent out by the laterals below and from the lower buds of the main shoot. Those marked B will probably flower next season.

Fig. 167 conveys an idea of the pruning practised upon these limbs. The dried quince is left merely to aid in comparing the unpruned and pruned branches.

Summer Treatment.

The summer treatment involves the following operations:—

a. Pinching the terminals of dominant leaders on young trees.

b. Disbudding misplaced surplus shoots.

c. Thinning out superfluous laterals and leaders in late summer.

In framing the trees the disbudding of the growing points to equalise growth all round the crown is very useful.

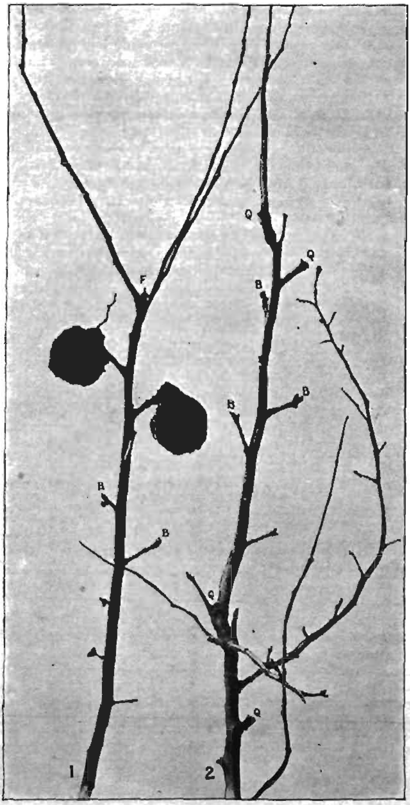


Fig. 166.
Typical Shoots of Quince.

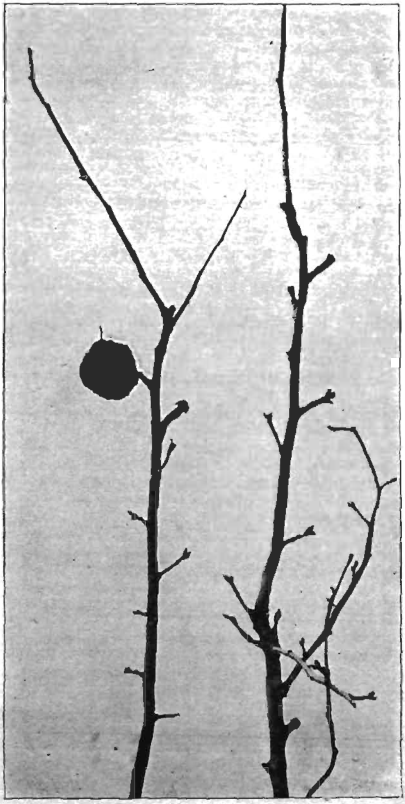


Fig. 167.

Pruning suggested for Quince Shoots.

The disbudding of misplaced shoots, or water shoots, can be practised throughout the tree's lifetime. Very rank growing trees, which have arrived at the normal dimensions of the quince and still refuse to carry fruits, may be reduced to a quieter condition of vegetation by doing all of the pruning in the late summer. About the time that the fruits of the quince are ripe will be found most suitable.

The thinning out of the laterals and leaders on trees of normal habits can also be done without injury when time permits in the late summer.

Renovating Old Trees.

We have noted the prevalence of water shoots arising from old limbs. Upon any kind of tree this is always a sign that renovation is easily performed. It is clear evidence of the vitality of the dormant buds and the suitableness of the bark to permit their emerging into active extension.

Old quince trees may be shortened back gradually or cut back completely to the main arms or stems, and good growth will ensue. If it is desirable to alter the variety, bark grafts put on to the stems or arms, or buds inserted into the young shoots where they emerge from the old wood prove effective methods. Great care must be taken to thin out the rank shoots during the following season, and permit none to grow from the stock above the grafts or buds. The tops of any emerging lower down should, by pinching out the growing points, be kept below the introduced shoots, and be finally removed at next winter's pruning.

THE FIG.

The wood of the fig, though brittle when bent sharply, proves to be very pliable under the natural pressure of a weight of foliage and fruit. Partly owing to this is it that we find most of the branches taking horizontal or drooping positions on our established trees. The tenacity with which the leaders persist, however, and the lack of guidance, have much to do with this habit. It is generally recommended that when the fruit is grown for drying purposes, the stem of the tree should be about the height of a man: when grown for marketing fresh, the stem should be shorter. The reason advanced for setting a high stem is because a good space beneath will be available for collecting the fallen figs. Figs grown for drying are often allowed to fall, or are beaten to the ground, when quite ripe, in those countries most celebrated for the production of this fruit. The reason assigned for framing the trees low when the fruits are to be used fresh is because they may be readily harvested without bruising.

In the production of figs in this country, the small bird nuisance takes the place of the insect and fungus pest troubles connected with raising other kinds of fruits. For this reason, also, a short-stemmed somewhat compact tree is advocated. The young tree should when planted be cut back in a manner closely resembling that advocated for other kinds. If it is a straight stick, of one season's production, the buds upon it will be active throughout the entire length If it has started to make side shoots at a convenient height, these should be retained and the central leader suppressed. If this leader is not cut away it will continue to force each side arm to a horizontal position. The main arms should not be allowed to lengthen too rapidly, and they may be pruned as safely as those on any other kind of tree when it is required to check extension. The dormant season is, of course, the best time to make any severe cuts, but the wounds should be dressed carefully without delay. The main arms, and secondaries arising from them, should be carried up obliquely with a tendency toward a vertical position. As the foliage and weight above increases, they naturally open outwards. All side shoots arising from these should be allotted sufficient space for the spread of their foliage. No branches should be allowed to bend across or down upon others.

In Fig. 168, a good type of the garden giant, as grown without any attention, is shown. The dense top growth and the height at which the fruit is borne condemn this type as uneconomic. The man beneath is 6ft. high, so the reader can guess the height and spread of the tree. If fruiting wood is to be maintained in the body of the tree, light must be admitted by preventing the centre from being shaded over too densely by top shoots.

The Annual Wood and Its Treatment.

On an ordinarily productive fig tree the annual growth consist of—

Wood shoots or leaders (which also carry fruits).

Fruit shoots.

Leaf twigs.

When too densely placed, some of the last summer's shoots may prove to be only leaf twigs, having failed to form figs in the leaf axils.

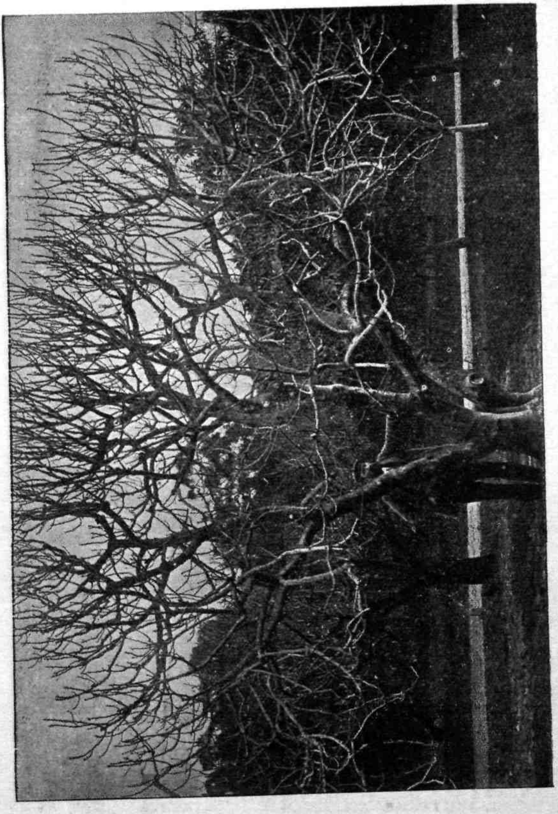


FIG 168.—FIG TREE: AN UNTRAINED GIANT.

In the production of its fruit the fig cannot be placed with any other deciduous fruit tree. Many varieties ripen two distinct crops here in the one season. Fig 169 depicts three shoots; (1) and (2) are fruit shoots, produced last summer; (3) is a season older. The photograph was taken when the first evidence of returning vegetation could be seen upon the fig trees. Starting from the base and following up each shoot, we see at every node a series of scars A. B each surmounted by a depressed bud. These scars show where the leaf stalks were attached beneath the buds. The buds show the possibilities for branches should the sap be diverted into them.

In several instances other scars may be seen above those left by the falling away of the broad leaf stalk. These indicate where fruits have been carried during the previous summer. As the terminal points are approached we see a number of small ovoid bodies marked C and F, which are really young figs. If the student examines similar shoots in winter he will see just the rounded top of some of these showing out of the axils of where the leaves have been. These little figs, like the flower buds of a peach tree, are formed late in summer in the axils of the leaves. They remain scarcely detectable through the winter, and extend out with the first leaves of spring. (It may be mentioned in passing that the fig is not a true fruit, the product of the fertilisation of an ovum, but a swollen receptacle upon the enclosed walls of which a great many flowers are carried.) Finally they develop into the *first crop* of figs, ripened early in summer. At the apex of (1) a long sharp-pointed leaf or wood bud W is seen starting to grow. Twelve months ago the top nodes of (3) marked A presented a similar appearance to those at F seen on (1). It will thus be noted when once the fruits have been carried no more are formed on that part of the branch, unless it be upon new shoots forced from the dormant buds located at these leaf scars. The taller shoot in Fig. 173 carries in the spring following, large figs at the base of the first leaves. These represent the small figs just emerging on (1) Fig. 169, and the growth above these figs shows what will be performed by the sharp-growing point W, just expanding in the same illustration. Along the middle portion a smaller series of figs are growing in the axils of the leaves; these are represented in the other illustration by the attachment scars only. The terminal portion of the shoot, which next winter shall hold the embryo figs previously referred to, has not yet been formed. We can therefore sum up the processes of the fruiting habit of the fig as follows:—*The first crop arises from embryo figs formed in the axils of the last leaves put forth during the previous summer. They were too late to develop further before the winter's cold stopped vegetative action in the tree.* They emerged, however, at the first burst of leafage in spring. *While they were increasing in size the terminal leaf bud grew out, and as it extended, other figs, known as the second crop, formed and developed out of the axils of the newly-formed leaves.* The terminal point still continued to extend, and, the season being far advanced, the tiny figs formed in the axils of the latest leaves remained dormant, to begin the fruiting cycle next spring.

We usually speak of the first and second crops because there is an interval during which no ripe fruits are found upon the fig trees. The statement, however, is only comparative, as the production or formation of figs by the tree is continuous during the whole of the season when active vegetative processes are in progress. *Any pruning of the terminal points of the shoots during winter must result in reducing the quantity of first-crop figs, as it removes the portion carrying those fruits in embryo. If*

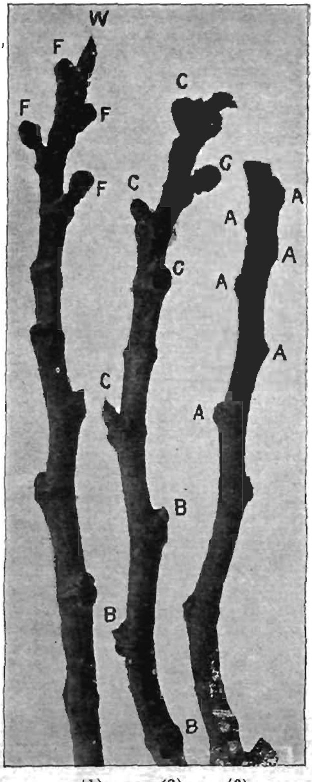


FIG. 169.

SHOOTS FROM FIG TREE.

(1) AND (2) REPRESENT THE CULMINATING POINT OF LAST SUMMER'S GROWTH. (3) IS THE LOWER PORTION OF THE LIMB FROM WHICH SUCH GROWTHS ARISE.

judiciously applied, however, it will increase the number of the second crop, as these are formed and ripened upon the current summer's growth. Fig. 170 shows a limb carrying a lot of shoots similar to (1) Fig. 169. With a view to retaining the compact habit of the tree, and keeping it within bounds as well as increasing the second crop, these shoots are pruned as seen in Fig. 171. The most extended are pruned back and the shortest retained to carry the first crop. The behaviour of these shoots

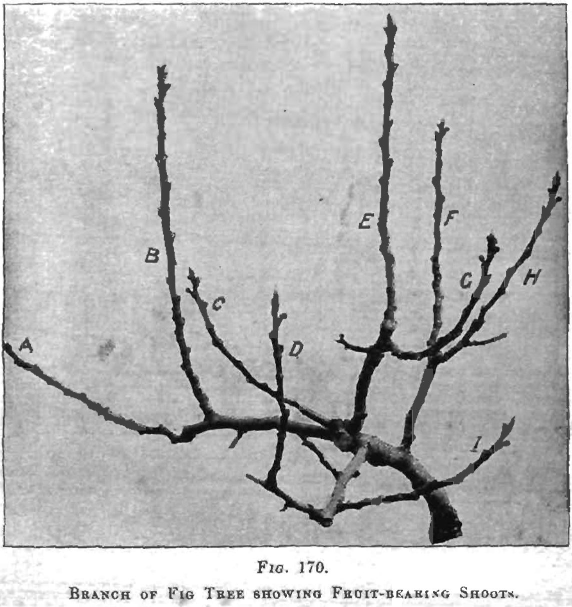


Fig. 170.

Branch of Fig Tree showing Fruit-bearing Shoots.

during the next summer is shown on Fig. 172. The letters will assist in tracing the branches which appear so dense in the picture. It will be noticed that each of the pruned shoots responded by producing several more. These all carried second crop fruits: but the clustered shoots should have been thinned in summer. On Fig. 173 two shoots illustrative

of the unpruned and pruned ones are isolated The pruned shoot with several branches can be plainly seen to carry more second-crop figs than the single unpruned shoot. The latter, however, carries a first as well as a second crop.

There can be no doubt that if fig trees are to be kept evenly balanced, and productive in the highest sense, a certain amount of pruning is required from the outset.

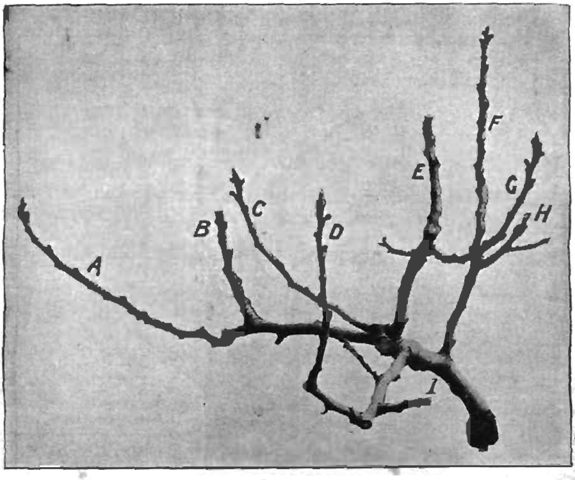


Fig. 171.

Pruning suggested for Shoots in Previous Figure.

[Note.—B. E, H, I. *have been Pruned.*]

Summer Treatment.

When branches are ascending too rapidly, the terminal points may be nipped off, thus producing a checking result. This tends to increase their stability and furnish them with side shoots. When any trees have been winter-pruned as described herein, the thinning of dense shoots is desirable in the interests of those retained. The minute disbudding operations resorted to under more severe climatic conditions are not required in Southern Australia. If shoots are shortened in summer, or even in spring, the subsequent growths therefrom seldom mature their summer-formed fruits.

The Renovation of Old Trees.

The fig lends itself to renovation readily. It may be shortened back to the main arms, or cut to a stump, in winter. The young shoots arising from the stump must be thinned judiciously when growth is in progress, as too many are always forthcoming. The established trees may be thinned out at the top, or any large unnecessary limbs may be

FIG. 172.

THE GROWTH OF THE SHOOTS ON THE PREVIOUS BRANCH AFTER PRUNING.

removed. The buds upon the old portions appear to possess wonderful tenacity of life. The shoots arising from wood many years old will bear fruits during the summer of their emergence, so that the treatment of barren water shoots calls for no explanation in connection with the

pruning of the fig tree. When it is considered desirable to change the variety the old tree may be cut back to the main arms when the sap is flowing with moderate freedom, and scions carrying two buds inserted by the method known as the rind or bark graft.

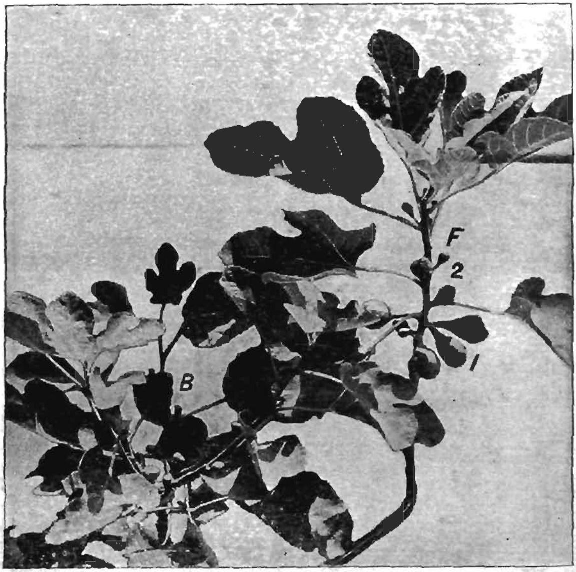


FIG. 173.

THE BEHAVIOUR OF A PRUNED SHOOT B, AND AN UNPRUNED ONE F, DURING THE FOLLOWING SUMMER.

PART III.

PRUNING OF EVERGREEN TREES.

With the exception of the olive, the members of the citrus family and the loquat include pretty well all of the evergreen orchard trees of any commercial importance which are grown here in the temperate portions of Southern Australia. Deciduous trees are mostly pruned when they are quite bare of foliage and the sap at rest. The pruning of evergreen trees is chiefly performed when the period of active growth is being resumed in early spring. There is a common belief, which takes no particular expression, however, that evergreen trees require no pruning. The questions of the necessity for the admission of light and air and the avoidance of diseases appear to be overlooked when these trees are under consideration. The thinning out of shoots upon other trees is accepted as a work of necessity for their well-being, but it is seldom practised upon evergreens. If it is necessary for the healthy development of the shoots, buds, and fruits upon trees which naturally admit light between their branches for half the year, it must surely be allowed that a great need for the practice of the pruner's art exists among trees that naturally shut out the sunlight all the year round. It is true evergreen fruit trees are mostly natives of sunny climes, but as the range over which the sorts under mention are grown embraces many degrees of latitude and varied sun temperatures, the treatment may in consequence be greatly modified.

If the question of protection from the sun's rays be advanced as the chief reason for allowing great density of twigs or foliage, it does not require a vast mental effort to see that a few broad healthy leaves growing more or less on a horizontal plane can afford more shelter to the sensitive bark beneath than many weakly ones forced by the struggle for light to take almost a vertical position. No one will contradict the value of the principles underlying the practice of thinning turnips in the field, but few recognise that much the same rules apply to the crowded shoots upon the evergreen tree. The climate in which evergreen trees are well suited is all the world over a favorable one for parasites which prey upon such vegetation. When extremes of temperature occur which tend to stay their ravages, a haven of refuge is provided for a fortunate few in the densely-foliated tree or shrub. In accordance with the degree of protection thus afforded so the survivors are to be numbered. In the culture of plants of economic value this consideration of shelter for pestiferous insects can be largely influenced by judicious pruning. In connection with fungus defects, the still, dark, humid conditions so essential to their development are found in the dense tree. Where light and air circulate freely these scourges find unwholesome surroundings. So much for the purely preventive value of the pruner's art; but of equal importance is the aid it lends in the effective application of artificial remedies for checking the ravages of insect and fungus pests. As the careful spacing of the shoots permits the ready circulation of light, air, warmth, and moisture, equally well does it permit the effective distribution throughout the tree of noxious gases or insecticidal or fungicidal mists artificially produced.

(1) (2)

FIG. 174.

TYPES OF CITRUS TREES AS RECEIVED FROM NURSERY.

Owing to the damage received in lifting the young tree from the nursery bed and in transporting it to its permanent position in the orchard, any shaping done in the nursery frequently proves of little value. The pruning to be applied at the setting out depends upon the condition of the roots, as well as the size and shape of the plant. Orange trees, around the whole of the roots of which the original soil *adheres in an unbroken ball, will require very little immediate attention.* Others again, whose tops are measurable by yards and the roots by inches only, must be pruned considerably or disastrous results will follow. Fig. 174 comprises these types as received from the nursery. (1) was set out as depicted herein, and (2) was pruned as shown in Fig. 175 immediately after being planted. The tree represented by (1) is in ideal *condition for transplanting,* as the buds in the axils of the ripened leaves are just beginning to start. Trees such as this require no top pruning. It more frequently happens, however, that young sappy brittle growing points several inches long have developed prior to the removal of the tree from the nursery bed. These *should be cut back to ripened* rounded wood immediately after the tree is set into its permanent abode. If permitted to remain they most assuredly will wither off and delay the starting of fresh shoots longer than if they were cut away. This practice is necessary even when the whole of the roots are apparently secured in the ball of earth. The connection between the terminal exten*sions of roots* and branches is so intimate that the slightest damage to the former, caused by the dry air playing around them for a few moments when being transplanted, will cause the delicate young leaves to droop. The tree seen in (2) is superior to the general types of orange trees after

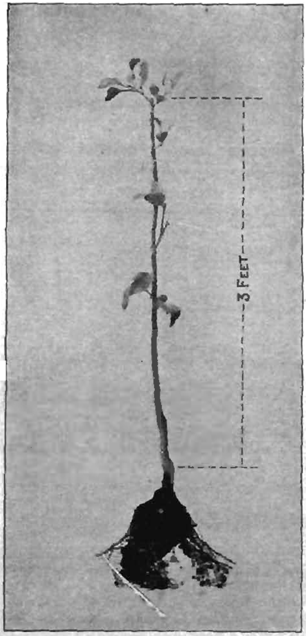


FIG. 175.
PRUNING OF (2) IN PREVIOUS FIGURE AT PLANTING TIME.

they have travelled any considerable distance from the nursery. It often happens that all the soil is shaken from the roots, either in lifting or in transit. Many of the roots are also broken and lacerated, more particularly *if the trees have been grown in deep rich nursery soils, where they may penetrate freely.* In such instances nearly all of the fibres are destroyed, and the ends of other larger roots broken off. The tree cannot in such a case draw up a supply of moisture to support the turgidity of the top and replace the water transpired from the foliage. It should therefore be shortened back much more than has been done in this instance, even though practically no foliage be left upon its stem or limbs. It is a good plan to cover the stem loosely with straw to avoid

FIG. 176.

FOUR YEARS LATER (1) IN FIG. 174 HAD GROWN INTO THIS.

injury from drying winds and sun-scald until shoots arise to provide the shelter so essential to the bark. When planting out the young tree the section left where the top of the stock has been removed should be carefully examined. Nurserymen in the hurry of cutting these off do not always exercise the amount of care required to ensure a rapid healing of the wound. If a short dry stub remains it must be completely cut away with a sharp knife and the wound dressed with lead paint to avoid contamination. In the writer's opinion the neglect of this very important work is one of the fruitful causes of "collar rot" obtaining a lodgment upon worked trunks of citrus trees. Figs. 176 and 177 are photographs

of (1) and (2) in Fig. 174 taken nearly four years afterwards, and their present condition fully justifies the treatment which was applied to them when planted. A tree, such as (1) represents, when planted out should be encouraged to establish itself during the first growing season. While this is proceeding the orchardist may observe suitably located side

FIG. 177.
PHOTOGRAPH OF TREE IN FIG. 175, FOUR YEARS LATER.

branches to encourage as leaders. These ought to be set as evenly around the trunk as possible, and must point away from each other. No branch which crosses another should be retained at this early stage, even though it be superior to the one beneath. This very important precaution is often neglected, and its correction in after years every

season's growth makes more difficult. The remainder should be retained, but prevented if necessary from robbing the favored leaders. This is done by nipping out their young points. Just when the growing season begins in the following year any of these lower limbs that can be spared without exposing the stem to sun-scalding may be removed if the

FIG. 178.

DENSELY GROWN YOUNG ORANGE TREE.

tree is progressing favorably. By doing this gradually in three or four seasons none but the main arms persist upon the original stem. It should be observed, however, that no lower branch be removed until an upper one is ready to supply the desired shade for the trunk. Three or four

main arms are sufficient to start the base of the tree. They should ascend in such a manner as to make a slightly outward oblique course from the main stem. If the growth continues good, at the second pruning—done early in spring just before the buds start—these mains may be topped off where suitable side shoots can be found at a desirable

FIG. 179.

SHOWING THE FRAMEWORK OF ORANGE TREE IN PREVIOUS PLATE.

[NOTE.—*The Thinning out is Exaggerated for Pictorial Purposes.*]

height. These shoots should point in a direction calculated to continue the course set out for the mains. The laterals in the centre of the tree may be restricted in their growth, but kept alive if possible. Those growing upon the outside of the main arms are spaced and thinned out if necessary. Their ends should be cut back on to firm wood above

lively buds situated on the top side, to give the growth which may arise therefrom an upward tendency. If such a course is not adopted the extending points will soon sweep the soil. This practice will be followed from year to year until the tree has reached its normal stature. It may appear as though the centre would be thrown too open by this method. Filling the centre of an orange tree, however, is a matter that usually looks after itself. If a leader opens outward too much, strong shoots will emerge at once from dormant buds on the inner and more vertical portion of that limb, and one or more of these erect shoots can be retained to continue, whilst the former leader is relegated to do the work of a side branch.

FIG. 180.

YOUNG ORANGE TREE, TWO YEARS OLD.

In Fig. 178 a vigorous young tree is illustrated. It grows with all the denseness assumed by young citrus trees when unpruned. Fig. 179 shows the method advocated herein being put into operation. The main and secondary arms are being spaced and the centre kept comparatively open. In this picture the thinning process is slightly exaggerated, to make the limbs more clearly distinguishable. The outside laterals are thinned out, spaced, and pruned as described. Fig. 180 is a photograph of a young orange tree (two years old) which would readily lend itself to careful manipulation on these lines.

If we refer to the tree in Fig. 175 we meet with an instance of a common source of trouble to beginners in training citrus trees. It frequently happens that the upper portion of such a tree makes no headway. For a time it sends out weakly twigs, which dwindle and fail, gradually dying back. Near the base of the stem side buds start and make healthy shoots of greater or lesser vigor. If these arise above the graft the grower should seize this opportunity and at once, if the sap is active or about to start, cut away all the upper part of the tree. This will concentrate its energies into the fewer buds and shoots at the base, and, other things being favorable, the tree will start into a healthy, thrifty growth. Fig. 181 shows a young tree which has gone through this experience.

While an orange tree is being built up the strong side limbs should be guided out to the circumference of the tree in a definite manner. The proper direction of each should never be lost. The orange naturally partakes more of the habit of a large arborescent shrub than of a tree;

FIG. 181.

TREE IN COURSE OF FORMATION FROM SHOOTS DEVELOPED BELOW THE ORIGINAL TOP.

consequently its spreading form is only modified to the extent rendered necessary by modern economic orchard cultivation. The stem should be short and the main arms stiff, so that the tree does not spread upon the ground when laden with fruit. The bark is thin, and readily damaged by sunburn, so that on permanent limbs it must never at midsummer be exposed unnecessarily. In Fig. 182 an orange tree of good shape is shown. It is about 20 years old, and although not quite 20ft. high, has a wide spread of branches. It is like a huge high-domed umbrella, and, when viewed from beneath, the main stem, main arms, and other subdivisions are bare of twigs; but there is a perfect canopy of foliage over the dome-like top and sides down to the ground.

The Treatment of Fruit-bearing Wood.

The orange tree bears its fruit upon the terminal twigs of the current season's growth. In consequence of this the crop is found upon the fringe of the foliage, and not in the body of the tree (see Fig. 183). To maintain a fruitful habit the tree must be kept in a steady growing condition, and to obtain even crops the annual wood growth must be properly ripened. The former is controlled partly by cultural treatment, and

Fig. 182.

A Well-shaped Orange Tree, 20 Years Old.

partly by pruning The latter may be governed by pruning mainly. The only pruning the tree receives in many cases consists of one portion of the bough outcrowding and suppressing another. This is natnre's pruning, and is unregulated, viewed from the fruit-producing side of the business. On Fig. 184 we have a photograph of a terminal bough of an orange tree. From one central shoot we see six distinct shoots arising.

They are all struggling for a share of the light and sap. The central one, being more favorably situated, bore an orange last year at the scar F S. The others in the middle are stunted, and those on each side plainly show in their branching tops and flower buds that they have been favored by fortune. The season before last this main twig grew and fruited where its top merges into the upper shoots above C. While this fruit grew the six side shoots referred to developed. Left untouched, we have six to fill the space occupied formerly by one. Certainly the area

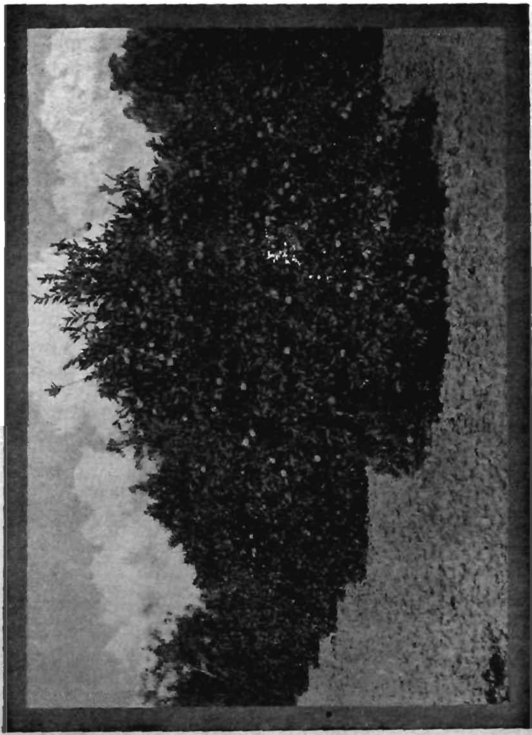


FIG. 183.—TYPES OF ORCHARD TREES (SALISBURY, S.A.) SHOWING HABIT OF FRUIT BEARING.

of the tree has widened a trifle, but not sufficiently to accommodate such an increased number. It is therefore only reasonable to assert that some of these branches must either perish by natural decline, due to being overcrowded, or they must be removed by the pruner. The process of the natural method of suppression weakens those which survive; the artificial method turns the energies of the parent shoot into useful

FIG. 184.

TERMINAL BOUGH OF ORANGE TREE, SHOWING CROWDED SUBDIVISIONS.

channels, and gently stimulates the tree. If the dense twigs are not thinned some die, and become hard and thornlike in character mechanically causing damage to the fruits borne by the survivors. The density of the bough forms favorable cover for insect pests, and renders the ..ange tree.

effective application of any remedial treatment a matter of great difficulty. In Fig. 185 the pruning of the bough in the previous plate is illustrated. This leaves room for the growth of the necessary subdivisions now appearing on each of these flowering shoots.

On Fig. 186 the natural method of subdivision of the fruiting wood is more clearly shown. The fruit scar F S being terminal, the extensions

FIG. 185.

TERMINAL BOUGH OF ORANGE TREE, WITH SUGGESTIONS FOR THINNING.

are lateral in position. While the fruit developed, side shoots emerged from the base of its stalk and grew to where they are now seen. If left they would have hardened, and in early spring sent out flowering twigs themselves, thus again showing the rapid multiplication of the fruiting

or flowering twigs. The pruning of such a growth would consist in removing the central piece carrying the fruit scar, if there were room for two shoots to remain. If insufficient space were available, only the lowest would be retained. The pruning of the fruiting wood may be summed up as follows :—*Cut away the shoot that has fruited, and save*

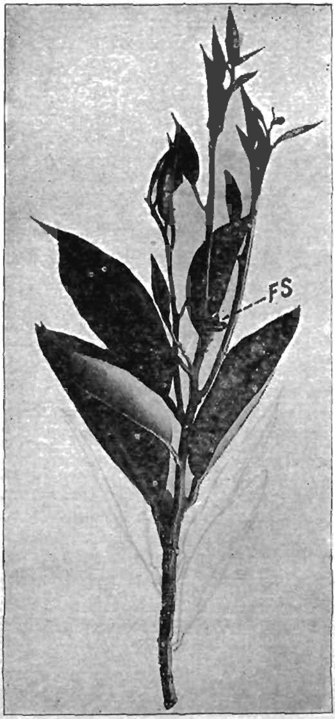


FIG. 186.

SHOWING HOW THE SUBDIVISIONS DEVELOP AROUND A FRUIT SCAR.

such of those arising from its base for which room is available, always giving preference to the replacing shoot lowest down. By this means the undue extension of the branches is restricted. This pruning should be performed as soon as the crop is off the tree—in early spring. Before the sun has gained much burning power the foliage of the young growth will fill up exposed spaces caused by pruning.

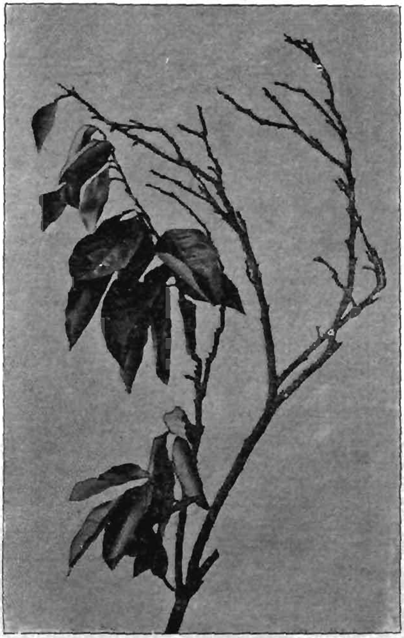


FIG. 167.
DECLINING SHOOT OF ORANGE.

Summer Treatment.

Throughout the summer it will be necessary to keep a watch upon the growth of water-shoots from old limbs. These should be rubbed out from time to time. Rank shoots arising from the tops of horizontal limbs, unless required in the framework, should also be rubbed off, as

they seldom fruit until they assume a large size and outcrowd better branches. A water-shoot may be used to fill a gap should such be present among the leaders or side limbs. When young trees are in process of formation, undesirably strong and misplaced branches may be nipped or pruned back, or cut away entirely, as the case demands, at any time in summer.

FIG. 188.

PRUNING RECOMMENDED FOR THE PREVIOUS SHOOT.

The Renovation of Old Trees.

Dead or dwindling wood must never be tolerated in an orange tree. It should be removed cleanly down to a good healthy side shoot. On Fig. 187 a shoot of this description is figured, and in Fig. 188 the pruning suggested is given. Sometimes after long, dry seasons or following exceptionally wet winters, the top of a tree will decline in the manner shown in Fig. 189. If such a tree be sound at the collar and main roots, renovation may safely be undertaken.

In Fig. 190 the necessary cutting back is illustrated. Every branch is shortened back to a healthy twig.

The growth upon this tree a year later is seen in Fig. 191. When declining trees are cut back in this manner the bare stems should be covered with sacking, or thickly coated in limewash, to protect them from sunscald. Grass or straw may be wrapped loosely around them for the same purpose. The growth of twigs should be encouraged as much as possible during

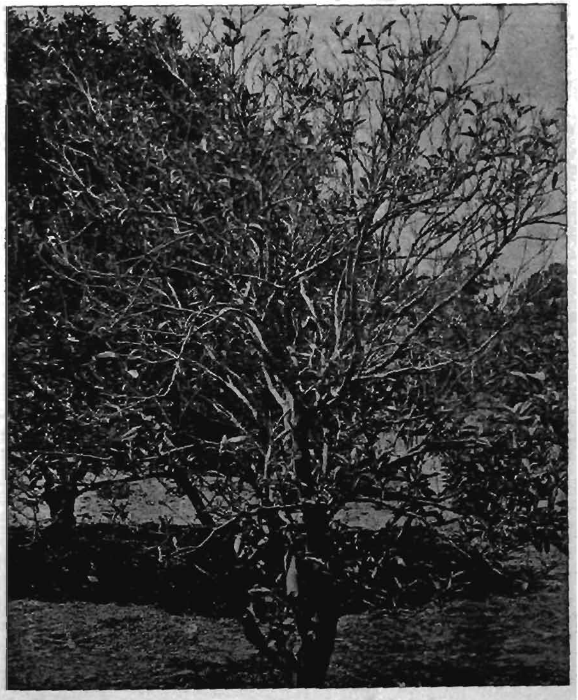


FIG. 189.

ORANGE TREE IN NEED OF RENOVATION.

the first summer, and any thinning will be done during the next spring. Liberal cultivation, water, and fertilisers are absolutely necessary if the best results are hoped for from any method of renovation. Old orange trees of inferior kinds, if healthy, may be cut back to stumps and re-worked by budding on to side shoots which arise from the trunk or main arms, or buds may be inserted into the arms direct. The growths arising from this method assist to heal over the old large wounds of

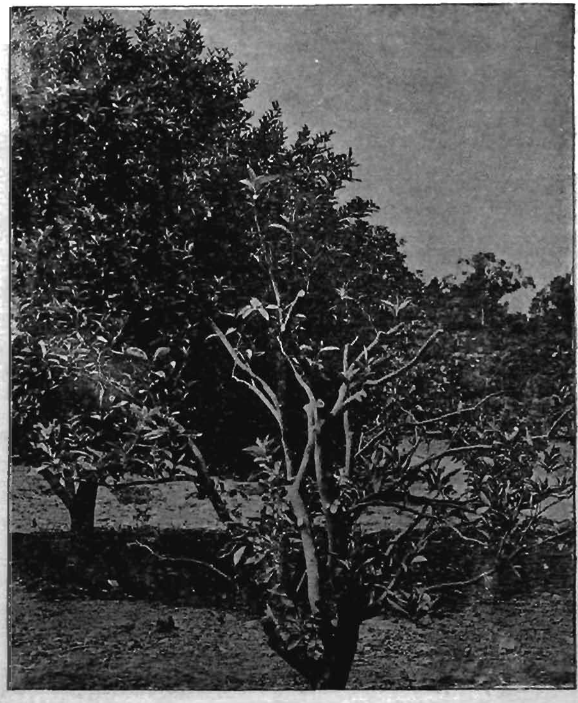


Fig. 190.

Pruning Suggested for Renovation of Previous Tree.

amputation much more rapidly. To attain the best results the buds should be inserted before the top is removed. A narrow ring of bark taken out all around the limb, just above the bud, will direct the sap into it. When the buds have united they are allowed to grow at will, and the waxed cloth bindings are removed. The old top is cut back in the following year, about early springtime. Trunks and arms of such trees should be thickly limewashed to protect them from the sun. Large arms should have several buds inserted around each, almost on the same level. This will help to close the wound and form the head more quickly. The growth of these buds under favorable conditions is very rapid indeed, and the sappy points should be pinched from time to time to give the shoots stability. Below the buds shoots from the stock may be allowed to grow for a season or two, until a fair balance between the roots and new branches is established.

Fig. 191.

How the Tree in the Previous Plate appeared a few months later.

OTHER CITRUS TREES.

These remarks are applied more particularly to the varieties of the sweet orange. They may, however, be applied in almost every particular *to the Mandarin types. The pruning of the different types of Mandarins must*, however, be modified in accordance with their respective habits of growth. Varieties such as the Japanese and so-called Thorny types possessed of a spreading habit must be pruned to upper shoots to induce a more erect form, and thus avoid the crowding of the branches and twigs due to the fruit bending the upper ones down upon those immediately beneath. The Canton Tangierine or Emperor

FIG. 192.

MYRTLE-LEAVED (BITTER) ORANGE, RIVER MURRAY, SOUTH AUSTRALIA.

types are of erect habit, and the above plan must be reversed just to the extent found necessary in separating the branches. The Japanese and Thorny types are often mere shrubs, and must be dealt with in such a manner as to prevent them taking a too recumbent form. All of these last named naturally grow very densely, and unless they are occasionally thinned out after the fruits are removed, the massed twigs become so dense through subdivision that many perish, and the remainder are so weakened that only small inferior fruit can be carried upon them. Owing largely to the lack of this necessary work many of the Mandarin trees in our gardens become almost barren. It may be mentioned that the Japanese section, as represented by the Satsuma, respond most freely to fairly severe pruning more particularly after the trees are established for a few years.

The bitter oranges, such as the Poorman, the Myrtle-leaved, Pomelo, and the more acid Kumquat and Seville are of stocky habit, producing tough densely-set foliage. The general pruning outlined for the sweet orange applies to these types. The Sevilles and Pomeloes sometimes grow strongly and may require considerable thinning. The Kumquat and Myrtle-leaved (see Fig. 192) are grown chiefly for their ornamental qualities.

The Citron has to carry exceedingly heavy fruits. In consequence the trees should be pruned to direct their growths in a vertical direction, so that when the leverage of the fruits is exercised the branches may not be brought right down to the ground. The permanent parts of the tree should be laid in very stiffly by restricting any efforts at too rapid an ascent on their part. As a rule when the principal leading shoots are well spaced very little thinning of the terminal twigs is required afterwards, as they do not subdivide so numerously after fruiting as those of most members of the citrus family.

THE LEMON.

The early formation of the lemon tree is conducted upon similar lines to those suggested for the orange. The lemon, however, being a more rampant grower, requires more attention after the first two seasons. The carrying up of the main and secondary arms, and the spacing of the side

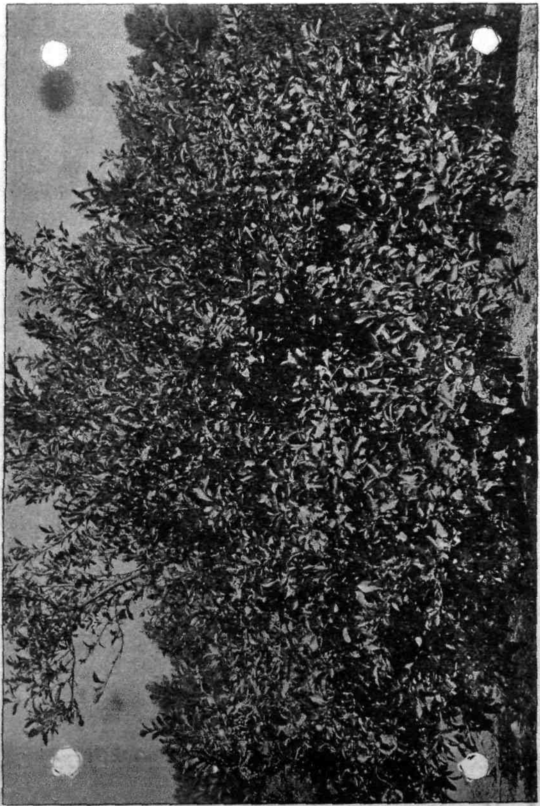


FIG. 193.—AN UNTRAINED LEMON TREE AT FULL BEARING AGE.

shoots therefrom, must be carefully followed. Care must be taken to prevent the centre of the tree being filled by too many rank water-shoots, which, by-and-by, would topple over and upset the symmetry of the more fruitful parts of it. The leading shoots should be carried out in a sloping direction, then, as they become bent at the ends, strong shoots will arise from the bends on the secondary arms and take up the positions of the former leaders. These erstwhile leaders are now displaced, and being forced to a lower plane receive less sap and become fruitful side-shoots. So, from year to year, the tree can be built up in a series of irregular tiers of branches radiating from the central permanent parts.

FIG. 194.

YOUNG LEMON TREE WITH OPEN CENTRE AND SPACED LIMBS.

If the lemon is left to itself it will send up rank slender water-growth in the centre, which, after a time, will bend down and become stiffened into a horizontal or curved position. From the top of such prostrate shoots, rank vertical growth again arises to repeat the operation at a later stage. This is the usual designing received by the average lemon tree of our orchards. It is not desirable that an attempt to suppress this characteristic should be made, but rather to guide and regulate it on systematic lines. Fig. 193 shows a tree in full bearing, framed in this manner, It is not a bad specimen, but there is an immense lot of crowded useless wood in it. The young tree on Fig. 194 is being trained in the manner

suggested herein, admitting plenty of light through the tree. The side shoots should be carried out to the margin of the tree's spread, on distinct lines. They must be pruned back from time to time to give them stability and force outside twigs from them. When pruning the ends of such side shoots. the bud chosen at the point to continue the extension should be varied in position, thus depressing and raising the branch in a zigzag fashion from time to time. This gives it stability and retards the

FIG. 195.

LATERAL BRANCH OF LEMON SHOWING HOW THE STRONGEST AND LESS FRUITFUL SHOOTS ARISE ON ITS UPPER SIDE.

rapid flow of sap to the extremity, to the benefit of the side twigs. The *object sought in building up the tree, by means of a series of branches* bending from a vertical position, is to establish a fruit-bearing habit. The quiet habit assumed by side shoots arising from such branches is conducive to fruit production. The vigor of the *vertical shoot does not* allow it to turn to fruitage until its subdivisions become numerous and

weaker. When shortening in side shoots of the lemon the cut should be made back into ripe wood. This tends to throw the sap into dormant buds better than when the pruning is done on fresh-growing parts. The side branches should be spaced so that sufficient light may pass between them to satisfy the needs of lateral wood arising along the whole length. Any light wood issuing from the inside of the more erect permanent arms should be retained, but no rank water-shoot tolerated, unless required to continue the work of some displaced leader.

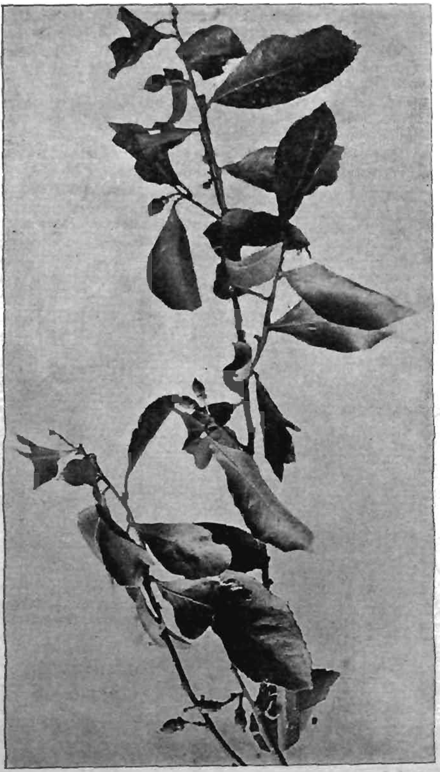


FIG. 196.

THE LEMON BEARS MOST FRUIT ON LATERAL TWIGS GROWING OUT OF HORIZONTAL BRANCHES.

The Treatment of the Fruiting Wood.

The best fruits are borne inside the body of the lemon tree; on the orange they are found on the outside. On the orange the terminal twigs alone produce first-class fruit; on the lemon the laterals all along the horizontal side limbs will bear. Assuming that we have side branches clad in growth, let us look at the value of the shoots. The side branch of a citrus tree on Fig. 195 conveys what is meant. The shoots A arising from the top side of the limb absorb most sap, and possess most vigor, but produce no fruit for some time. The less stimulated shoots B underneath are going to bloom. In pruning the light wood upon the branches we suppress the vertical shoots, and retain those upon the sides. This appears to be the key to the pruning of the lemon for fruit production—check the vertical shoot and encourage the horizontal only. Build up the sides of the tree from the bottom; the centre will always supply the necessary branches to raise the top when required. Fig. 196 conveys a fair idea of the method followed by the lemon of fruiting upon small laterals. As the laterals extend away and hang down by reason of fruit carrying, they should be shortened back towards the parent branch. No crowding should be permitted, and crossing or tangled branches as well as dead or worn out laterals should have no place in a well-kept lemon tree. The observation of such precautions will prevent much of the scratching and rubbing so commonly a cause of depreciation in lemon fruits.

The summer treatment and the methods for renovating old trees advocated for the orange are applicable to the lemon also.

THE LOQUAT.

Commercially, the loquat is grown more as a shelter to other kinds of fruit trees than for the fruit alone. The fruit, however, sometimes proves very profitable. Being an evergreen, the branches have always to carry a considerable weight of stiff heavy foliage. The height of the stem must be decided by the object for which the tree is grown. In Fig. 197 a type of tree about 20ft. in height, with a clean stem between 4ft. and 5ft. high, is shown. Fig. 198 represents a tree with a stem about 1ft. in height. When grown as a shelter belt the outside rows should be trained high, as in the first plate, and the inside row low, as in the second type.

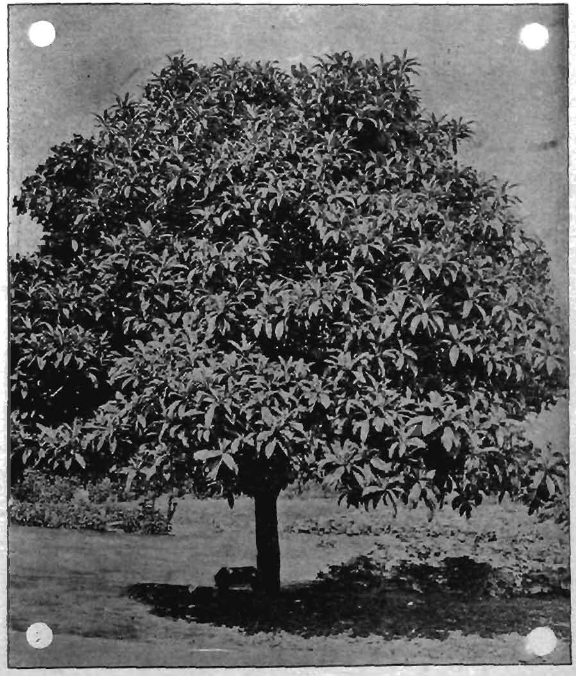


Fig. 197.

Loquat Tree with High Stem (Grown as a Shelter Tree).

When grown for the fruit only, the latter type would on the whole prove *most economical. The main stem of the loquat tends to persist and* maintain its supremacy. In shaping a high-stemmed tree the natural bushy habit should be encouraged for several years, taking care that the side shoots by no means outstrip the central leader. The ascension of the leader in the meantime must be encouraged to its utmost. The side *shoots are retained at this stage by way of strengthening the tree and*

Fig. 198.—Loquat Tree (on Quince Stock) grown for its Fruit Only.

yielding fruits. When the main stem has reached a height of about 7ft. or 8ft. the side limbs may be reduced from the bottom for a distance of about 4ft. up the stem. This is best done just before the tree starts to grow in autumn. The main stem should also receive a check by having its point cut out to the next subdivision below it. The top shoots will now be the selected main arms to form the head of the tree, and should be encouraged accordingly. As they grow, topping should be resorted to from time to time, to induce secondary arms and other side shoots to form and fill the space. The length to select for the mains and secondaries will depend upon their individual strength. They must be made sturdy, as the weight of leaves and fruit is constantly being carried at a

FIG. 199.

SHOWING HOW YOUNG SHOOTS ARISE AROUND A FRUIT STALK.

greater distance out from them, and exercising an increasing leverage power thereby. The number of subdivisions to maintain will depend upon the space to be filled. No branch should grow immediately above another, because the overshaded one must eventually suffer and pass out of existence. As the top ascends and expands the lower branches are trimmed away gradually until the main arms are the only ones emerging directly from the stem. In the course of time, owing to the increasing burden of foliage and fruits upon their extremities, the main and secondary arms will be brought from the original oblique direction assumed by them down to a horizontal one.

In training a tree upon the low system, shown in Fig. 198, the main arms should be selected during the first growing season after the tree is set out. Those selected should be encouraged, and their competitors checked by topping. If the selected arms are satisfactory, all the others may be removed at the end of the first summer; if the tree is not yet well established they should be retained, but restricted through another growing season. The rest of the treatment in training the tree would be similar to that adopted with the taller type.

(1) (2)

FIG. 200.

LOQUAT SHOOTS.

(1) FROM YOUNG TREE. (2) FROM OLD FRUIT-BEARING TREE.

The Treatment of the Fruiting Wood.

The fruits are borne upon branching flower spikes, which emerge from the terminal points of the shoots in late autumn. The fruits develop slowly through the winter, and ripen in spring. Upon trees of quiet vegetative habit the shoots of the previous season carry these spikes. If the tree be vigorous, as is often the case with young seedlings, many years may elapse before fruits are carried. At the base of the fruit or flower spike a number of leaf buds are formed. We have noted, in the case of the apple and pear, where the flowers are terminal

(1) (2)

FIG. 201.

PRUNING SUGGESTED FOR THE PREVIOUS SHOOTS.

the extension of the fruiting wood is lateral. In Fig. 199 three shoots are seen arising from the base of the old dried fruit stalks. This increased number is usually too great for the space available, and overcrowding and weakness results. These shoots should be retained in sufficient numbers to fill the available space, and no more. In Fig. 200 two types of shoots are drawn; (1) is upon a somewhat vigorous branch, the other cut from an old tree. In the first instance, the shoots require thinning; in the second, the old decaying fruit stalks should be cut away. This is completed in Fig. 201. The removal and destruction by fire of these old stalks and fruits takes away the most fruitful means of perpetuating the black spot (Fusicladium eriobotryæ), fungus disease, so injurious to these fruits when grown in damp localities.

PART IV.

GRAPE VINE PRUNING.

THE GRAPE VINE.

The Structure of the Shoot or Cane.

The structure of the wood of the grape vine, and more particularly of the ripe annual shoots, technically known as "canes," with which the pruner is chiefly concerned, differs from that of any other kind of fruiting plant which has been heretofore described. In these shoots we meet for the first time a clearly defined division of the cane into nodes and internodes in the internal more than in the external structure.

If Fig. 202 be examined it will be seen the internode consists of a large central pith enclosed in an encircling layer of woody tissue, which in turn is enveloped in a thin, closely adhering covering of bark, composed of continuous and closely packed parallel fibres. The node, on the other hand, holds no central pith, its place being occupied by a wedge-shaped septum, composed of a mass of partially lignified tissue less fibrous in character than the external layers which surround it. Upon the external woody tissue, where the upper edge of this wedge joins it, the bud is attached. The bark casing at the point of emergence of the bud is differentiated into a number of scales, which fold together and completely envelop the embryo shoot, which, wrapped in a mass of protecting hair-like fibres, is contained therein.

The value of this non-pithy septum, or diaphragm, as a protection for the more readily decomposed pith has long been recognised in vine-growing countries, and the section at the base of a cutting is made through it whenever any portion of a cane other than that which has been attached to an older shoot is used for propagating. In wet countries the pruners often cut through these woody divisions when severing canes, but this precaution does not appear to be necessary under Australian conditions, in so far as avoiding decay is concerned.

Physiologists claim to prove that the bud is—for nutritive purposes—primarily connected with the internode above it, and that when the bud starts in the spring-time it withdraws the stored nutriment which has rested in the internode immediately above it. Hence, it is claimed that a measure of gain may be secured to the vine by cutting through the node above the topmost bud retained. Whether the vine be benefited sufficiently to

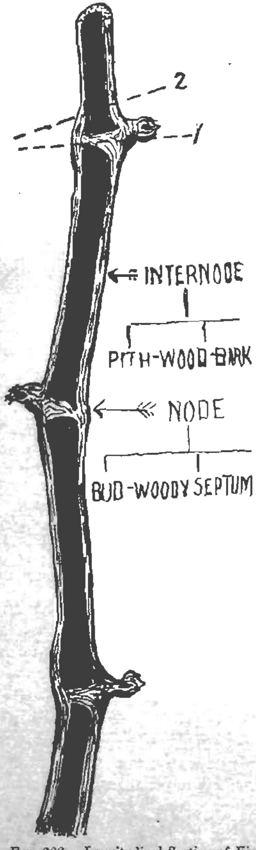


FIG. 202.—Longitudinal Section of Vine Cane, showing positions for Pruning at 1 and 2.

compensate the owner for the extra labor incurred in severing these dead terminals at the next winter's pruning is open to question, but the possibility of injury to the grape vine during tillage operations is certainly increased by the long projecting internodes, more especially if left upon very vigorous types of bush vines.

On the other hand, wherever bush vines have rods left upon them or the canes of trellised vines are systematically tied, these terminal internodes present a distinct advantage in permitting secure tying without constriction of the cane taking place, and consequent stunting of those growths arising from buds which may be located beyond the position of the ties. Competent authorities are agreed, however, that when the section is made through the internode it should slope away from the bud, but at the same time it should not be made as close down to the bud as is recommended in pruning fruit trees, owing to there being a greater danger of the shoot arising from the topmost bud on the grape vine cane blowing off under strong wind pressure. (See 2, Fig. 202.)

THE PARTS OF THE VINE.

In Fig. 203 a diagrammatic grape vine is given. It is meant to convey in graphic terms the nomenclature which is applied to the various parts of a fully-grown grape vine, whether it be trained as a bush or in trellised form.

Arising from the soil, we have the *trunk or main stem*. From this, in turn, arises the *main arm or arms*, and from these again are developed the *secondary arms*. The stem and the main arm alone are claimed to be the permanent parts, as the secondary arm, whether on bush or trellised vines, invariably

extends through the annual increments gained from each winter's pruning until its renewal becomes a necessity (see Figs. 204 and 205). From the secondary arm arises those annual *shoots or canes* which are most valuable on account of bearing buds which produce the crop in the coming summer; hence, they may be called the fruiting wood. A further examination of our diagram reveals the presence of other annual growths which do not take their rise from the ends of the secondary arms, but they come direct out of the stem or main arm, or may be they arise from older portions of the secondary arms. These growths are technically known as *water-shoots.* This is owing to their great vigor of growth and because they emerge from wood more than one season older than themselves. These water-shoots do not as

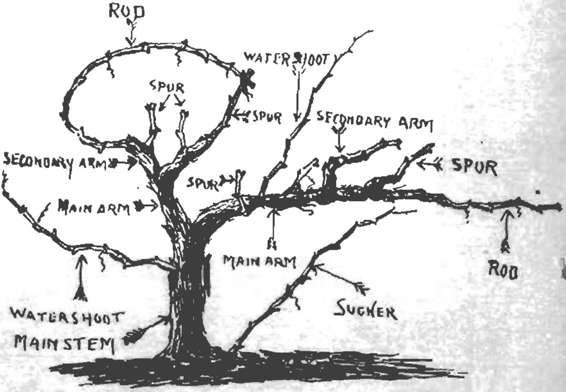


FIG. 203. Diagram of the Parts of a Grape Vine.

a rule carry buds from which fruit can be expected in the following summer, consequently they are not relied upon as fruit bearers. They possess, however, two points of value—firstly, if a gap exists in the framework, an arm to fill it may be developed from the water-shoot; or in the case of secondary arms or spurs becoming exaggerated in length, a properly placed water-shoot affords an opportunity of renewing the said arm or spur (see Figs. 204 and 205). If the water-shoot is not needed for either of the above purposes it is completely suppressed. The second value attributable to the water-shoot is instructional, because its presence—and more particularly if in numbers—indicates incorrect judgment on the part of the pruner. In the latter case it shows most clearly the vigor of the vine has been underestimated in the number of buds left upon it at the winter pruning (see Fig. 206)

Another type of annual shoot, seen in our diagram, arises from the soil. This comes from a subterranean bud upon the buried portion of the stem. It is called in viticultural parlance *a sucker*, though more correctly speaking it is an offset. This shoot has no value, excepting the top of the parent vine be irreparably damaged, necessitating a complete removal of the stem, when the so-called sucker may be trained into the position formerly occupied by its parent. This, of course, is only adopted when the decapitated vine was originally grown from a cutting.

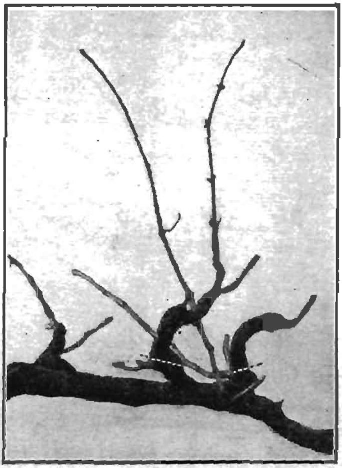


FIG. 204. Trellised Vine.
Reduce Old Secondary Arms at the Dotted Lines.

We are now in a position to sum up the parts of the vine: The main stem, the main arms (permanent parts); secondary arms, fruit shoots, water-shoots, suckers (temporary parts).

RESPECTIVE VALUES.

The main stem supports the framework, lifting it the desired height abo the soil. The main arm supports the secondary arms, which carry the ann fruiting shoots. The water-shoot and sucker have values as replacing sh under certain circumstances only.

THE TREATMENT OF THE FRUITING WOOD.

An examination of our diagram shows that those shoots which have arisen from what has been retained of the growth of the previous season are pruned, but they have not been all treated alike. Some have been cut so that only two buds are visible upon them, whilst others have been bent over in the shape of an arch, or tied straight out horizontally. These are the portions of the canes retained after pruning takes place, and they are technically known as spurs and rods respectively. We may therefore define ***a spur as a portion of the last season's wood carrying from one to three buds.*** In noting the

FIG. 205. **Bush Vine.**
Extended Secondary ***Arms to be*** **Cut Off at Dotted Lines.**

buds, only those between which distinct internodes may be seen are counted. Consequently, such as may be placed in the angle where the young shoot joins the previous season's wood are not taken into consideration. ***A rod has been described as a portion of the previous summer's cane, possessing from 10 to 16 buds;*** but it would be more clearly described as a portion of such shoot carrying a greater number of buds than a spur, as in practice the rods chosen on strong vines often do not possess 10 buds.

It would be simpler, if it were practicable, to prune all grape vine canes into spurs, but as the object of growing the vine is the production of grapes, the habit of bearing peculiar to each variety must be kept in mind. Observations made over many years go to show that under normal conditions of growth some vines produce the buds upon the lower ends of their annual canes, from which alone shoots arise bearing bunches of flowers. On the other hand some kinds—usually those capable of displaying great vigor of vegetation—produce their flower-bearing branches from buds situated well out along the cane. Others, again, produce bunches more or less all along the

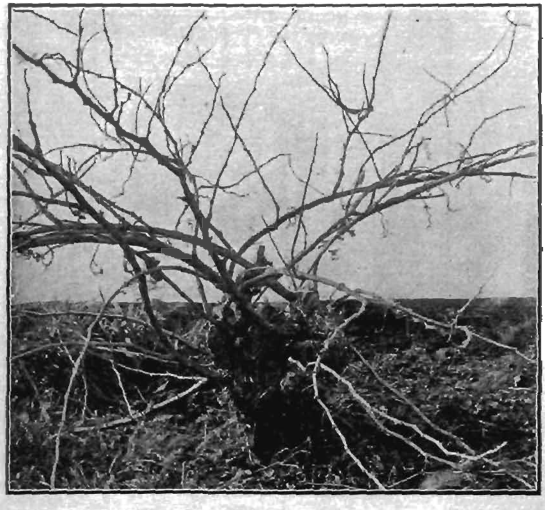


Fig. 206. Hard Pruning applied to a Vigorous Vine results in many Watershoots.

ripened canes. These observations have led vinegrowers to classify their varieties into spur-pruned and rod-pruned types. It should be observed, however, that a vine which is rod pruned entirely is never found. Owing to the necessity for constantly renewing the fruiting wood and keeping the development of the framework of the plant within proper bounds spur pruning, either wholly or in part, must be resorted to.

In practice, a very vigorous vine of the spur-pruned section should not only be permitted to retain a greater number of spurs, but each spur may al

carry the full number of buds, whereas a weak vine of the same variety should have its spurs in reduced numbers, and each spur may be reduced to one or two buds. If the pruner misjudges the capabilities of the vine, be it rod or spur pruned, he should, by leaving a greater number of spurs and buds, reap a harvest of numerous, but inferior fruit, and obtain only weakly shoots to supply the next season's fruiting wood. On the other hand, too severe suppression results in forcing dormant or adventitious buds to grow out into water-shoots, or possibly suckers. (See Fig. 206). The happy medium secures fine quality fruit along with strong, well-ripened canes for next year's operations. Generally speaking, for table grapes or raisins it is desirable to prune hard to keep up the quality of the fruit, although water-shoots occur with moderate frequency. In the case of grapes for wine-making leading authorities affirm that in good strong soils where the vines are vigorous, rod-pruning is applicable to most of the varieties usually classed among those spur pruned. On the other hand, when subjected to artificial modes of restricting the sap, such as "cincturing" or "ringing," now so widely applied to the Zante Currant, spur pruning alone affords the best results.

The following is a classification of the methods of pruning applied to some of the leading varieties :—

Spur Pruned.—Aramon, Black Hamburgh, Black Alicante, Black Malaga. Black Frontignan, Black Mammoth, Belas Blanco, Buckland Sweetwater, Carignane, Chasselas, Doradillo, Dolcetto, Duke of Buccleugh, Early Green, Gros Colman, Grand Turk, Grenache. Gamay, Gouais, Lady Downes' Seedling, Lady's Finger, Mataro, Muscat Gordo Blanco, Muscat Alexandria, Muscat Hamburgh, Madresfield Court Black Muscat, Pedro Ximenes, Pride of Australia, Palomino Blanco, Red Prince, Royal Ascot, Royal Muscadine, Red Malaga, Sweetwater, Santa Paula, Trebbiano, Trentham Black, Temperano, Ulliade, Verdelho, Wortley Hall.

Rod and Spur Pruned.—Crystal, Carbernet, Centennial, Daria or Ohanez, Malbeck, Pinot, Quick's Seedling (Cornelian), Quick's Early, Raisin des Dames, Riesling, Sultana, Shiraz, Sauvignon, Waltham Cross, Sercial.

Rod and Spur or Spur Pruned.—Black Prince, Black Frontignan, Black Malaga, Corinth Currant, Mrs. Pinces' Black Muscat, Red Malaga, Red Frontignan, Trentham Black, Zante Currant.

FORMS OR SYSTEMS OF TRAINING.

Grape vines are naturally climbing plants, but under cultivation for economic reasons are trained either as low bushes or as climbers on trellises. The form given the bush vine is known as gooseberry bush or goblet; while the trellised vines are divided into (1) spaliers or espaliers, (2) cordons.

THE GOOSEBERRY BUSH OR GOBLET.

The model to be kept in mind when forming the gooseberry bush vine consists of a single stem or trunk, carrying two or three short main arms, each of which on strong specimens may be subdivided again into secondary arms, on which, in turn, the fruit-bearing wood is borne each year.

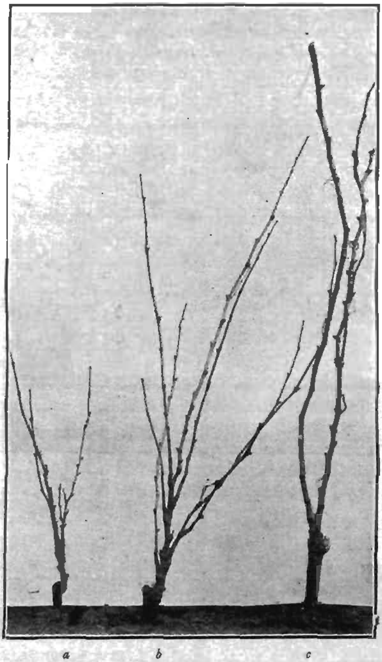


FIG. 207.—One-year-old Vines before Pruning.

THE STEM.

The height found most suitable for the stem under Australian conditions varies from about 8in. to 18in. It is rarely in Australia the bush vine is grown in localities sufficiently frosty to necessitate the use of a higher stem to lift the foliage out of danger. With a stem about 9in. long the vine is

able to resist all ordinary wind pressure in exposed positions; but unless care in framing the body is observed, the bunches of fruit may trail in the soil and become damaged. This point is of greater importance in respect to grapes when grown for table purposes than with those produced for winemaking or even drying. It is generally accepted to be a fact, in cold countries at any rate, that the grapes ripened close to the warm soil are richer in sugar than those produced at an elevation of several feet above it, and in training their vines this knowledge is borne in mind by winemakers as well as by those who dry their grapes for raisins.

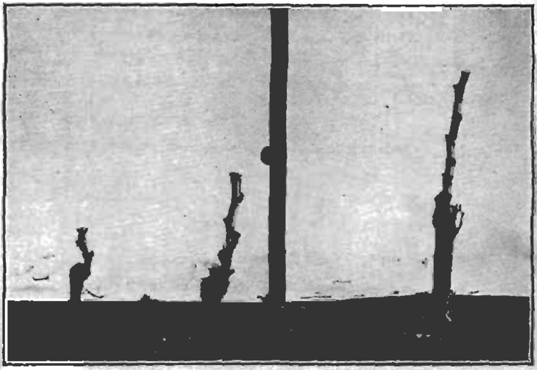
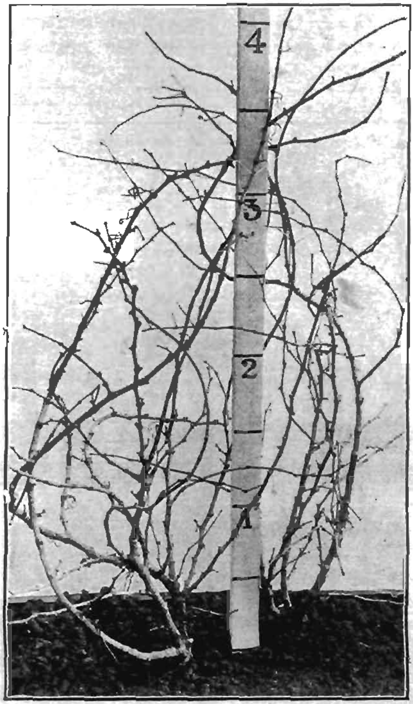


Fig. 208—One-year-old Vines after Pruning.

PRUNING THE YOUNG VINE.

The vines photographed on Fig. 207 represent the varying types of rooted vine-cuttings commonly dug from the nursery. It is true, seldom are these plants as strong as those shown in (*b*) and (*c*). Usually they are as weak as (*a*), and, in consequence, the first pruning must be of a drastic nature. This consists of reducing the plant to a single shoot and suppressing all but one or two buds upon that one. This leaves it projecting about 3in. or 4in. out of the soil only, and frequently at the next winter pruning the shoots arising from these buds are erroneously chosen for the main arms. This is an attempt to save time, which results in forming the vine too low—so much so that in later years in roughly-tilled soil the plant appears to be stemless, and to raise the fruit out of the dirt the main arms must be permitted to become unduly exaggerated in length.

In Fig. 208, the first pruning of the three vines is depicted. It will be seen that of the three only (*c*) was deemed sufficiently strong to cut to the height desirable for the stem. The vines represented by (*a*) and (*b*) are required to make a shoot in the coming summer from which the stem may be formed.



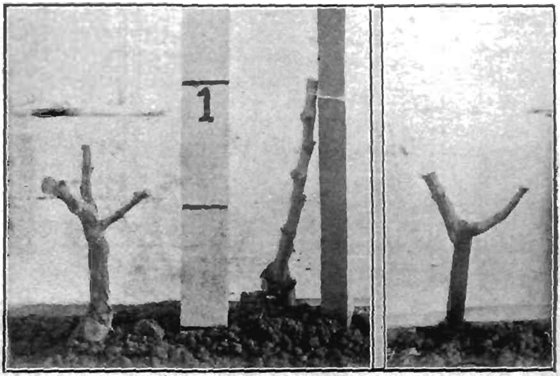
d *e*

Fig. 209.—Two-year-old Vines before Pruning.

Therefore, wherever practicable, the strongest shoot or shoots arising from such vines should be secured to a stake to give them a vertical position. If great care be observed, under specially favorable conditions, only one

shoot may be permitted to ascend ; but, generally speaking, for the purpose of strengthening the plant, all the shoots and foliage should be conserved during the first summer after transplanting takes place.

A strong young vine pruned as (c) in Fig. 208 should be fastened to a stake to establish it in an upright position, as has been done with (e) Fig. 210. When the second winter pruning season arrives (c) will present something of the problem indicated in (d) Fig. 209, the solution of which is seen in (d) Fig. 210, where three evenly-placed canes have been cut back to spurs which are eventually to be the main arms. It is not often three strong shoots are produced



d *e*
Fig. 210.—Strong Two-year-old Vines Pruned.

Fig. 211.—Two-year-old Vine Pruned.

in this closely-spaced manner, and most frequently the pruner has to be content with two, as shown in Fig. 211.

The vine (*e*) in Fig. 209 represents the growth anticipated on grape plants after being pruned as (*a*) and (*b*) have been in Fig. 208, and the second winter pruning of such is instanced at (*e*) Fig. 210.

It may be remarked here that during the early stages, when tieing to stakes is necessary to straighten the stem, the pruning sections should be made through the node above the highest bud intended for growth. This enables the tieing material to be tightly fixed around the stake and the terminal internode without restricting the sap in its course to the buds.

A well-grown type of vine, three years planted, and ready to receive its fourth pruning, is illustrated at Fig. 212. This is as (*d*) Fig. 210 should be when

a year older. It will be observed that several main arms are branched, but these were too closely set to permit of the branches being used as secondary arms; consequently a spur has been retained on each of four evenly-spaced arms. The growths which arise from the buds on these shall form the

Fig. 212.—Three Years Planted and before Fourth Pruning.

secondary arms, and as they are to complete the goblet-shaped framework the buds chosen are those projecting from the sides of the canes and not from either the top or under surfaces. *It is desirable to follow this practice even* if the spur retained is extended by an additional internode and bud.

Fig. 213 shows this vine pruned back to spurs, each carrying two or three buds.

The bush vine is now formed, and the annual treatment, if spur pruned, will consist of retaining a sufficient number of spurs on the plant to utilise

FIG. 213.—After Fourth Pruning.

FIG. 214.—Type of Mature Gooseberry Bush Vine when Pruned.

its energies in the *production of good crops of fruit*, as well as the development of strong annual canes to maintain the same. A good type of a moderately vigorous mature vine grown as a gooseberry bush and spur pruned is given in Fig. 214. Some of the arms of this vine will soon need reducing in length as the accumulation of scars formed by the dead tissue which arises from

FIG. 215.—Four-year-old Vine before Pruning on Rod and Spur Method.

the wounds made at each winter's pruning will retard the flow of sap to the terminal spurs and the growth and crop will diminish. The pruner should, therefore, watch for the appearance of a water shoot low down on any extended branch and utilise it to replace the worn out member. If no such watershoot

appears, a single spur only should be left at the end of the too extended arm, and it should be cut back to one bud only, as this restriction of the outlet for the sap at the top often results in forcing out a watershoot lower down upon the arm

Rod Pruning.

A four-year-old vine unpruned is photographed at Fig. 215, and at Fig. 216 the same plant rod pruned is depicted. This is called "Rod pruning," but in reality it is not strictly so, as one spur or more is retained with each rod. The best results are obtained from certain varieties of grapes when rod pruned, and this is more particularly correct when they are grown to

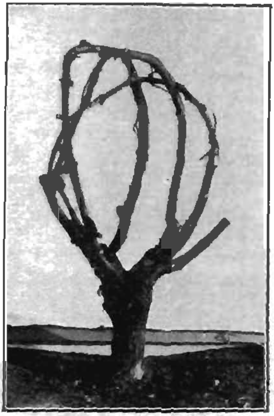


Fig. 216. – Four-year-old Vine, Rod and Spur Pruned.

gooseberry bush shapes. In this case the rod is the fruit-bearing part, while from the buds on the spur arise the canes which shall form the rod and spur for the next season's operations, *as the old rod after fruiting is completely suppressed* at the next winter's pruning. In this form of pruning it is seen *the spur is a greater factor in maintaining the shape and dimensions of the vine than the rod*, and, consequently, the canes, which lend themselves to these objects are pruned as spurs, and those canes of average strength which are farthest away from the permanent portions of the vine are selected to bear the fruit for the current season.

To increase their chances of setting the berries, the rods are often twisted, bent around, and tied to the ends of the spurs. In Fig. 216 this is displayed, but in practice the rods should be bent around the circumference of the

framework of the vine rather than be arched over the top. This latter method tends to shade the centre of the vine too much, thereby injuriously affecting the ripening and color of the fruit as well as, in the case of vines growing in low lying or damp positions, encouraging the growth of parasitic fungi. The number of rods to leave upon a vine should be based upon its general vigor. A weak plant may have one or two only, and a strong plant three to five; but in any case more spurs should be made than rods, as an increase in vigor may demand the necessary canes for an increased number of rods at the following pruning.

General Considerations.

In approaching a mature vine, whether spur or rod pruned, trained as a bush or trellised, the pruner must observe the vigor of the plant as illustrated in the growth of last season's canes. If they are numerous and very spindly and weak it will be desirable to prune hard, allowing a lesser number of spurs or rods or both, as the case may be, than he observes were left at the previous winter; and just so far as the weakness of the plant indicates so these spurs should be individually shorter. A very weak rod-pruned variety may need reducing to a few spurs only, as this practice usually results in a lessened number of shoots, which are individually stronger.

During all of these operations the pruner should have formed a firm conception of the shape to which it is desired the vine should be trained. On the other hand, he may find himself in the presence of vines displaying an exceptionally strong series of canes with possibly many watershoots. As previously remarked, these show a vigorous constitution in the plant, for which sufficient vent has not been allowed last season when pruning. The remedy is to leave a greater number of spurs and, if it be a variety needing rods, a greater number of rods, than there is evidence of having been left last winter. A pruner entering a strange plantation to prune may be confronted by unknown varieties. In such a case he should carefully scrutinise a number of the vines showing different degrees of vigor, and observe where the bunches of grapes have been carried and how many of them. If the shoots arising from the spurs left at the previous winter's pruning have borne fruit freely, then the variety may be spur pruned; but if there is little evidence of such a result, rods should be used wherever the condition of the vine permits.

TRELLISED VINES.

From an economic point of view the trellising of grape vines is undertaken for the purpose of utilising in fruit production the vigorous growth obtained from many varieties when planted in strong soils. Although, to a certain extent, this is an extension of the principle observed in retaining rods on bush-grown vines, it does not completely fulfil the same purposes, as some kinds, even when trellised, require to be rod-pruned if full crops of fruit are to be harvested from them.

Apart from the purely economic aspect, grape vines are often trellised for the purpose of covering unsightly buildings, shading sun-exposed walls, or ornamenting arbors, pergolas, &c.

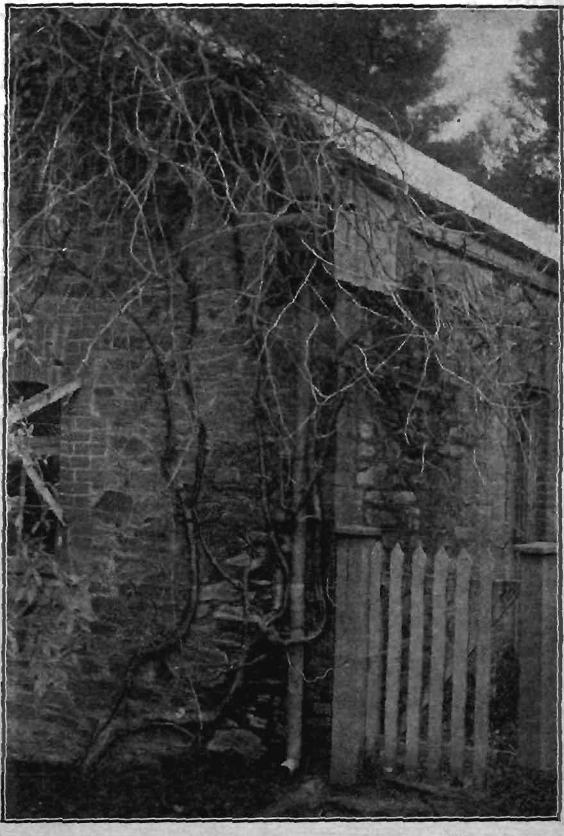


Fig. 217.—A Vine Trellised, but not Systematically Trained. An Ineffective Method of Covering a Wall with Vines.

It may truly be claimed that under favorable conditions of soil and climate nearly all vines, whether of rod or spur-pruned sorts, would yield much heavier crops if trellised; but the initial cost of the trellising is considerable, and this fact often deters the owners from thus training the plants. Further, the impediment to cross tillage of the land—so desirable under the dry conditions prevailing in many parts of Australia—is also an argument against the use of trellises.

Assuming, therefore, that trellising is done for the purpose of securing growth and fruit over all of the space afforded by any such structure, it becomes necessary to follow a systematic plan in the training of the vine which shall secure this end over the longest possible period of years.

Fig. 217 fairly represents the too common lack of system as displayed in many of the vines grown by amateurs for the purpose of covering an unsightly wall. In dealing with some observed facts in the growth of plants which underlie the principles governing pruning, attention has been drawn to an unvarying superiority enjoyed by the topmost shoots in receiving sap. Whilst this cannot be too strongly emphasized in respect to shoots on the grape vine, it must be also admitted that trellising affords a means whereby this advantage—which in standard trees, or bush vines, is secured by certain parts—may be minimised and distributed to all with an evenness not possible under any other method of training. This leads us to the expression of the one great principle upon which the most successful trellising of the grape vine is based, and that is, *the permanent parts of the plant must be so arranged that all annual growths (fruit shoots) may arise from a common level.* This means, therefore, that the permanent arms—if more than one be used—on any given vine shall be trained, not only horizontally, but on the same level above the soil. By most persons who trellis grape vines this is a principle which is either not fully grasped or is allowed to become overridden by a desire to secure growth and fruit over too large an area in the early stages of training the plant. The trellising depicted in Fig. 218 is a good illustration in point. Here the pruner of a number of the vines evidently started correctly, but had grown "weary in well-doing" and departed from the first principle involved, with the invariable result that the annual growths now arise here and there in haphazard fashion about the trellis, with the ever-increasing tendency to become more and more abundant on the upper branches of each plant as those below are robbed of sap and starved out of existence. This result is not arrived at until a few years after the vine begins to bear. Let it be trained and hacked about never so unskilfully, the natural prolificacy of bearing displayed by the grape vine in this climate, appears to reward the pruner, and sound the praises of his methods for a time. The day of reckoning, however, is bound to follow in the shape of long naked limbs, crowned with a crop of fruiting wood at the very topmost positions only.

Wherever a high trellis has to be covered, as is attempted in Fig. 218, several tiers of separate vines should be raised in regular series one above the other, so that the permanent arms on any given plant emerge at the same level from their parent stem. The application of this is clearly shown in Fig. 218A.

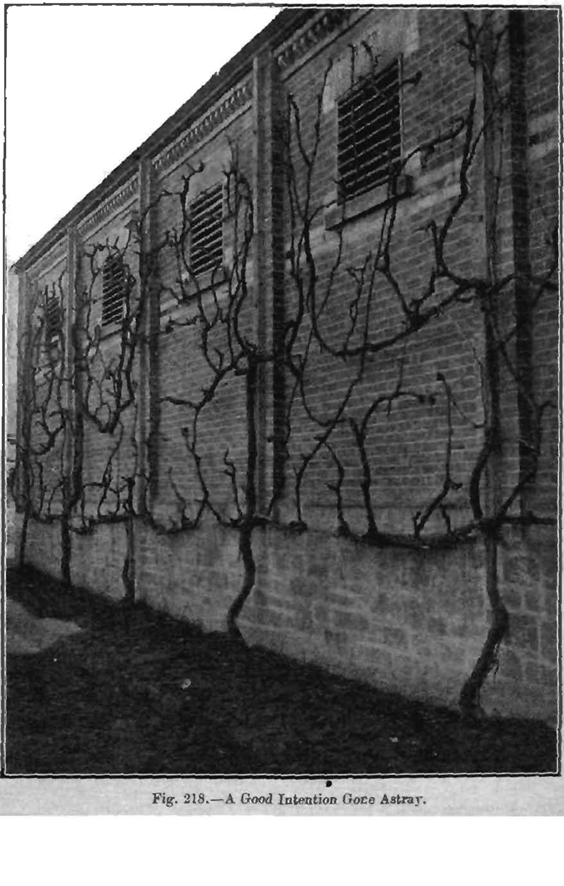


Fig. 218.—A Good Intention Gone Astray.

There are points common to all trellised vines, which have been noted already in respect to bush vines, probably the most important being the reduction of overgrown secondary arms per medium of the utilisation of water-shoots.

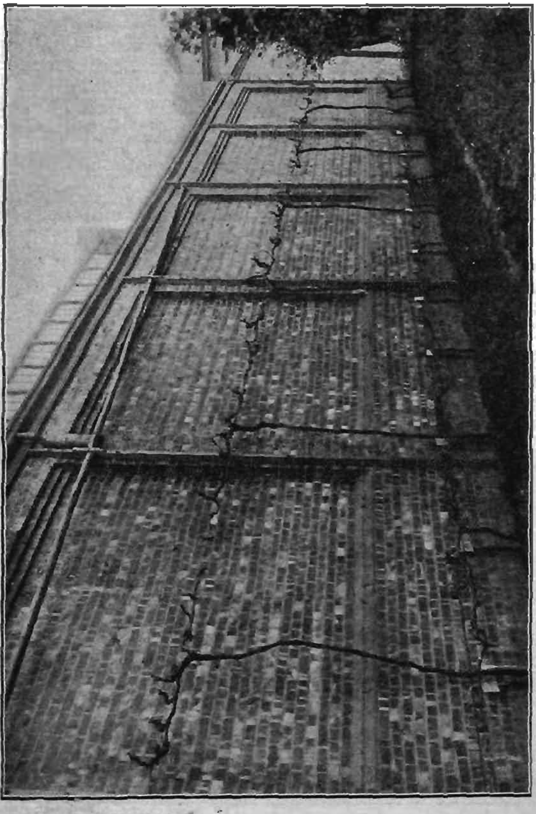


Fig. 218A—Systematic Training on High Wall.

In training the main arms, experience shows that it is false economy to twist them around wires, as such an act ultimately results in the necessity

for removing the wire from the swollen folds of the arm, or constriction of the sap vessels will take place to an injurious extent. The pruner must

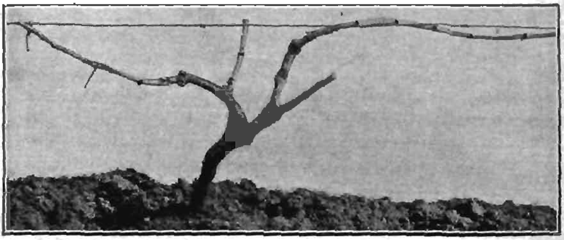


Fig. 219.—Forming Bordelais Spalier: Fourth Winter Pruning.

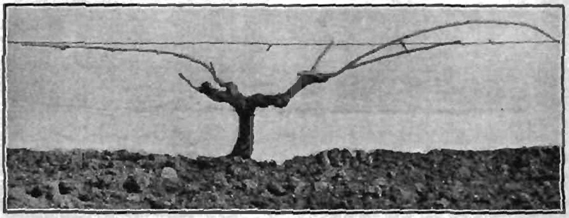


Fig. 220.—Bordelais Spalier (Vine of Moderate Strength).

distinguish between twisting the temporary cane, which is left a few months for fruit production only, and the cane retained permanently to form the extension of the main arm. Authorities agree that in no case should spurs or rods be tolerated which arise within about 9ins. of the bend or angle made where the vertical stem merges off into the horizontal main arm or arms, as the position is one of considerable advantage for receiving sap, and any such shoot almost invariably robs the growths situate farther along the main arm.

THE SPALIER.

This is the term applied to *a trellised grape vine on which a permanent arm is trained out from the stem at the same height on each side and in the same plane*, each pair—if more than one pair is retained—being on the same level.

Some forms of spaliers have several pairs of such arms, each set of which emerges at regular distances along the main stem—one above the other. Owing, however, to the great and constant care required to regulate the activity of vegetation in the arms thus set at varying heights, such a form is not recommended for use, excepting to such persons who may desire to follow the work of trellising purely as a hobby, and devote considerable time to pinching back shoots in summer. The best and most simple type to follow in spalier training is to permit one vertical stem only and one pair of horizontal arms—be they short or long—to each vine. To attain this end the newly planted vine is, as has been recommended for the bush vine, pruned back to a single spur of one or two buds, with a view to inducing at least one very strong shoot to arise during the ensuing summer. This shoot should be secured to a stake or upright support as it ascends.

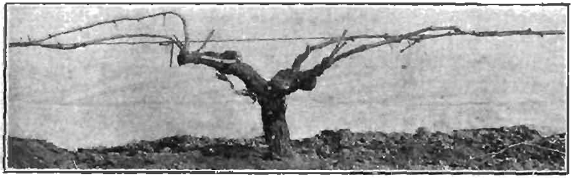


Fig. 221.—*Bordelais Spalier (with Four Rods and Four Spurs: Vine Strong).*

There are two types of spaliers suggested for use here in Australia, viz., the *Bordelais* or *Bordeaux spalier*, which possesses a pair of extremely short main arms, resembling the prongs of a fork, and the Thomery spalier (named after a district near Paris), in which a pair of arms is, with the exception of on a few varieties, permitted to extend much farther away from the parent stem, but in a horizontal position.

The Bordelais Spalier—Figs. 219, 220, 221.—This form has been recommended by our former Government Viticulturist (Mr. A. J. Perkins) as suitable for adoption in connection with the growth of certain wine grapes which need rod-pruning, such as Pinot, Carbernet Sauvignan, Shiraz, &c., when planted in comparatively poor soils. This form is suited to a cheap trellis of two wires; and the authority quoted above advocates 12in. to 15in. above the soil as a suitable height for the bottom one, to which the annual fruiting canes or rods are tied, and a second wire about 20in. above the lower one, to support the growing shoots. The type consists of a stem about 10in. high, on each side of which in the direction of the wire is one short main branch bearing each, according to the strength of the vine, either one rod and a spur (Fig. 219), or two rods and two spurs (Fig. 221.)

The vine is trained by pruning to one spur at the second winter season the shoot which arises the first summer after planting, and this at the requisite height to form the stem. The pruner at the same time sees that the two topmost buds are on opposite sides and face the wires. The following summer these two upper buds are encouraged to make good shoots. Next winter both of these are pruned as spurs, with from three to six buds each, thus forming the fork-like main arms, and the resulting growth should give at least two good canes from each arm. The following winter one of each of these is pruned to a spur for wood production purposes and the remaining two are made into canes for fruit-bearing in the coming summer (see Fig. 219). *The vine is now formed, and the annual pruning consists of suppressing the previous year's rods, removing all water-shoots and suckers, and converting two shoots of the previous summer's growth to a spur and rod respectively on each main arm;* or, as previously stated, strong vines may carry two rods and two spurs on each side, as shown in Fig. 221. In all such operations the spur, being reserved for wood production, necessarily regulates the framework of the vine and is in part comparatively permanent in character, whilst the rod is used for a temporary purpose, viz., fruit-bearing. The spur, therefore, to prevent undue extension, should be made from the cane situate lowest down upon the main arm in the direction of the main stem. In the course of time, even with the constant exercise of this precaution, the main arms must become exaggerated in length or impoverished with old scars. The pruner should then use his judgment in securing their renewal by means of suitably placed water-shoots, as described heretofore.

THE THOMERY SPALIER.

An imperfect form of this spalier is most commonly applied here by growers to table-grape vines when planted in strong soils, as well as by irrigationists in the production of grapes for raisins.

TYPE.

The type consists of a perfectly vertical stem carried to such a height as may meet the requirements of the trellis, as described later; and out of this, almost on a level with the wire or other support against which they will be secured, two arms emerge in a horizontal position, making on each side, as nearly as possible, a right angle with the stem. *On these main arms the* fruit-bearing shoots, consisting of spurs and rods, or spurs only, as the variety demands, are located at distances as nearly equal as possible apart. The general practice is to establish the spurs 6in. to 9in. apart when used alone, and rods accompanied by spurs are not permitted to remain closer than *from 15in. to 18in. distant from each other.* These spurs, or rods, should

project alternately from the sides, rather than from the tops of the main arms, thus broadening the frame of the vine.

Forming the Vine.

Assuming the newly-set plant has been pruned back to one spur of one or two buds only during the previous winter, in the early summer a strong shoot is encouraged to grow from one of these in a vertical position. To secure exactness, as soon as the height desired for the stem is reached, attention should be given, and when this point has been passed by several leaves

(a) (b) (c)

Fig. 222.—Forming the Thomery Spalier, dotted lines showing positions of (a) First Pinching in Summer, (b) Second Pinching later in Summer, (c) Next Winter's Pruning.

upon the tender tip of the shoot, this tip should be pinched off back to the bud immediately underneath the desired height (see (*a*) Fig. 222). In a few days another shoot arises from this bud, but being weak at the start, it forms very close joints, *i.e.*, short spaces between the buds. This shoot is nipped off at the point as soon as it reaches about an inch in length, but its successor is allowed to persist and gather strength for the remainder of the summer. The distances, however, between the lowest buds upon it remain unlengthened (see (*b*) Fig. 222).

At the next winter pruning the shoot is cut off at the desired height just above where the growth started last summer after the second pinching was administered (Fig. 222 (*c*)). Here two buds will be found almost on a common

level which, in the coming spring, will usually start as those have done upon (B) Fig. 223. The average vinegrower, however, will not give the necessary attention to secure these exact results, and the writer knows of many instances of well-balanced arms being secured by following the practice of one summer pinching, as illustrated in (A) Fig. 223. In this the shoot is trained up against a support vertically—a tall stake will answer until the desired height be attained—when it is pinched off to the bud immediately under that point. The young growth which rises from the top bud usually makes a weakly start with several internodes, each only about an inch long; but as the

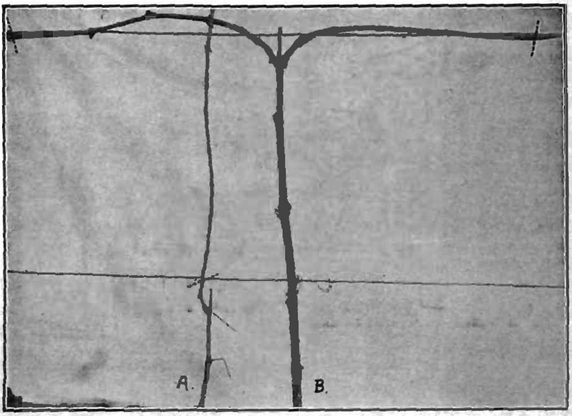


Fig. 223.—*Forming the Thomery Spalier. A, Shoot with ordinary development after being pinched once in Summer; the short joints will be noted; position of next Winter Pruning dotted, assuming the arms will be trained on the lower wire. B, Resulting growth before receiving Third Winter Pruning at dotted lines.*

shoot swells these appear to shorten, and when at the next winter pruning the shoot is severed at the wire, or position where the top of the stem is to be, the growths resulting from the two topmost buds emerge sufficiently near to a common level to secure for all practical purposes evenness of balance to the main arms of which they are the foundation.

Whichever of these methods are adopted, the shoots from these two buds are encouraged during the next summer to make strong growth. After they have extended about 1½ft. and lost their brittleness, they should be bent

down to a horizontal position. Although this operation retards to a certain extent their vigor, it is essential for the purpose of securing that perfectly horizontal direction which could not be so readily reached when the shoots have stiffened to the degree attained by them when the next winter pruning season arrives. When this time comes around the vine will have assumed the shape indicated by (B) Fig. 223, with the exception that small laterals will probably have grown from some of the buds upon the horizontal arms. These arms are now shortened back to a length which may vary with the respective vigor of each, the weaker one being shortened more than the stronger. In no case should these arms be retained to a great length—about 3ft. or 4ft. is quite long enough for the most extended development,

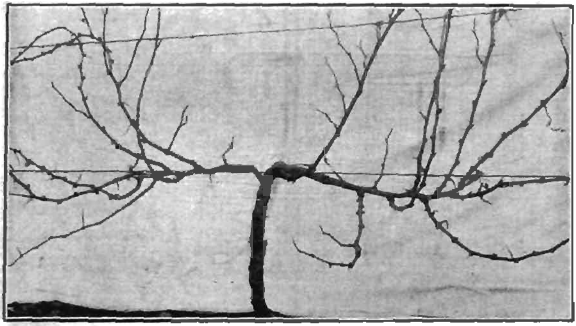


Fig. 224.—Thomery Spalier before Fourth Winter Pruning.

whilst on the average from 1ft. to 2ft. will be safer lengths to adopt. The danger of allowing long extensions during the first season or two arises from the fact that the buds upon such arms rarely break into growth with the regularity desirable, and consequently unduly long spaces remain unfurnished with fruiting wood. When severing the canes which are to be laid down for main arms, care should be taken to bend each one into the horizontal position it will assume when tied, and then cut it off *through the node immediately beyond a bud which occupies a position upon the underside of the cane.* The section is cut through the node, or bud knot, to permit tying operations being performed with complete safety to all buds upon the cane. The reason for retaining the terminal bud upon the *underneath* side of the cane is to ensure that *the curve made by the terminal shoot shall lie below the line of the parent cane.* Such a curve will straighten up as time passes, but the bend

made by growth from a bud situate upon the top side of the cane does not readily sink to the level of the rest of the arm even after the lapse of many years, and during all of that time it acts as an impediment against the free flow of the sap to the portion of the arm situated farther out. If any small laterals have arisen from these horizontal canes during the first summer they should not be cut as spurs, but suppressed completely, as a bud to be seen at the base of each one will replace them in the coming summer. It

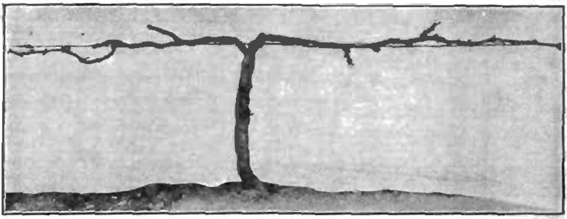


Fig. 225.—Thomery Spalier after Fourth Winter Pruning.

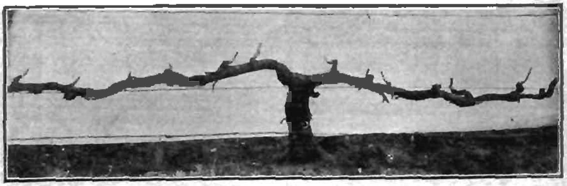


Fig. 226.—Mature Thomery Spalier: Spur Pruned.

goes without saying that any side shoots upon the stem, or suckers from beneath, should have been suppressed in the previous summer; but if any such remain at this winter's pruning they must be completely eradicated.

The appearance of a Thomery spalier before receiving its fourth winter pruning may be seen at Fig. 224. It will be noted that the buds upon both arms have, without exception, grown into fairly strong shoots. They are, however, much too closely placed upon the parent limbs, and many must be suppressed. The attention of the reader is drawn to a shoot emerging from the arm on the right of the picture, near to its junction with the main stem. This shoot is the most vigorous on that side. This vigor is due to its close proximity to the main stem, and thus obtaining more than its share of the sap. It

demonstrates the necessity for observing a rule in designing the Thomery spalier, which *forbids the retention on the main arms of any spur or secondary arm within about 9 inches of the main stem.*

The pruning recommended for this vine is illustrated in Fig. 225, where it will be seen, besides the continuation rod, only two spurs have been retained on each arm, and these are about 9in. or 10in. apart. The extension rods

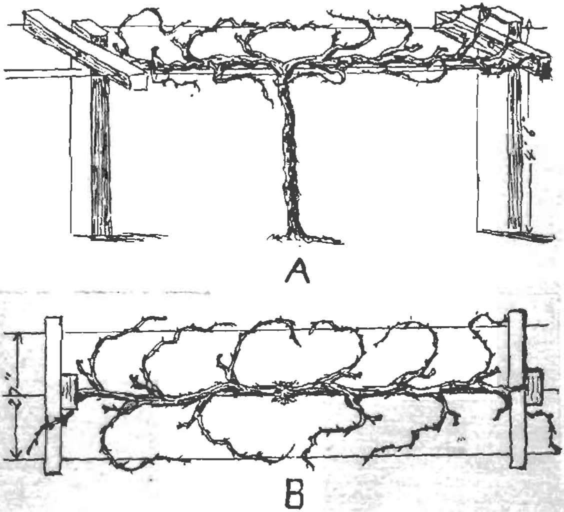


Fig. 227.—Hardy's T-piece Form of Thomery Spalier, used in growing the Zante Currant.
A, Elevation of Trellis.
B, Ground Plan; Vine viewed from above, showing spurs and rods.
(This method of training is recommended for very vigorous spur-pruned vines grown under irrigation.)

at each end have been cut about 15in. long, and the underneath buds have been again selected at the end of each rod. The downward bend upon the annual *extension of the arm on the left of the picture is very pronounced, but the* "pull" of the sap will help to straighten this up to the wire after a year or two has elapsed.

The after pruning of this vine would consist each winter of maintaining these spurs upon the permanent arms, *adding others on similar lines* along the extension of the previous season, and laying down a short extension rod or

spur until the space allotted to the arm be filled. From time to time, here and there, an exaggerated spur which has really become a short, crooked, secondary arm, must be shortened back to a watershoot which has arisen from its base or from the main arm, either at its junction with the old spur or thereabouts. A spur-pruned Thomery spalier of mature formation is illustrated in Fig. 226.

In the case of such varieties of vines which need spur and rod pruning, instead of one shoot of the pair which arises from each spur being suppressed, that one farthest out from the main arm is cut to a rod and bent down, whilst

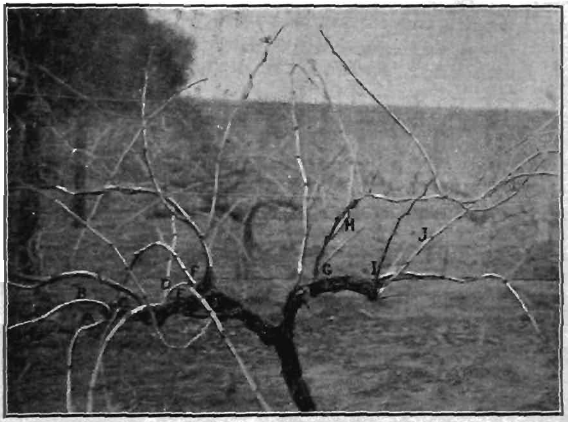


Fig. 228.—Sultana Vines trained as Thomery Spaliers with Short Arms.

its fellow arising from the bud nearest to the bottom of the spur is itself pruned to a spur to supply two shoots for the next season's work. This rod, after bearing its fruit, is cut away completely at the next winter's pruning. This is shown in Fig. 227, which represents the modification of the Thomery spalier as adopted so successfully by the late Mr. Thomas Hardy, of Bankside, in the growing of the Zante currant. In this the great vigor displayed by the currant vine is allowed to expend itself in a larger number of spurs and rods, without massing the foliage and excluding the light from the buds and bunches beneath to the extent which takes place when all the shoots

are distributed on the same plane as that assumed by the stem. Since the adoption of the cincturing process, as explained later, rods are only used upon Zante currant vines when they are displaying exceptional vigor of vegetation.

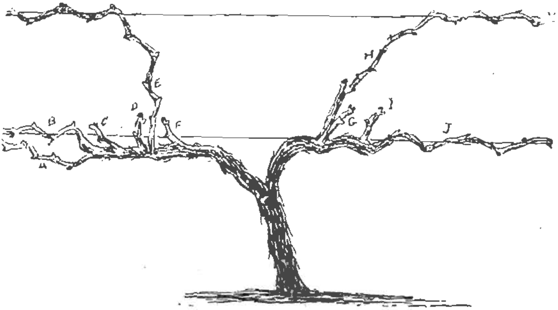
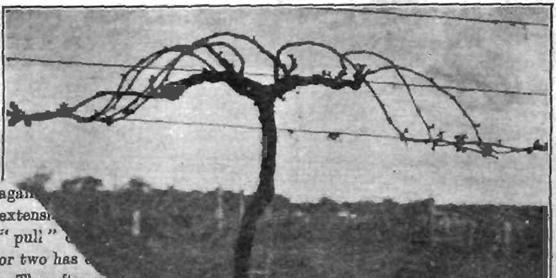


Fig. 229.—Thomery Spalier: Pruning suggested for Sultana Vine in Fig. 228.

The Sultana vine, depicted in Fig. 228, shows a modified type of Thomery spalier found applicable to the training of that variety. In this vine, it is true, the design is badly executed; but the reader's attention is drawn to the very short main arms—not above 2ft. long—although the vine is about 12 years old. This modification is suitable to all vines the main arms of which have a tendency to run into spaces bare of spurs if extended far away from the trunk.



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F.. 229A—Sultana Vine with Rods Bent Down.

Among table grapes, Waltham Cross and Centennial display this tendency very freely. The pruning often applied to such a vine is given in Fig. 229, from which it will be seen that the effort of the pruner is directed towards forcing out from the spurs on the main arms a number of very strong rods each season, about half of which are cut back to spurs, whilst a number—which varies with the vigor of the individual plants, and even with that of the arms on the same plant—are retained for bearing the fruit in the coming season. These rods are twisted at each internode and tied round in an arched form

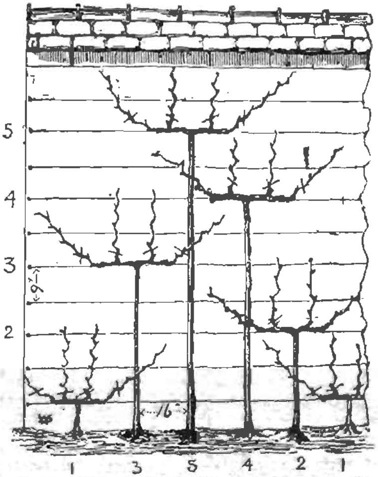


Fig. 230.—How to Cover High Trellis Work with Vines trained in Thomery Spalier (after Foëx). From "Vine Pruning," by A. J. Perkins.
Places for winter pruning indicated by cross lines.

to the wire supporting the main arm, or raised to the next wire, around which they are freely twisted, or, better still, bent down and tied to a lower wire if it be present. This is illustrated in Fig. 229A. When the vine is pruned the horizontally-trained annual rods are not used for the further extension of the main arms, consequently they are also twisted around the wires. The twisting recommended for the fruiting canes constricts the sap vessels and causes a steadier flow of the sap to the extremities of the vine. This reacts favorably upon the spurs, assisting in the production of a strong growth of canes for next season's use. It also regulates the supply

to the buds upon the twisted canes themselves, assisting those situate near to the main arm as against undue absorption by those located towards the outer end, which otherwise would monopolise most of the vigor. The twisting should not be performed until the sap begins to move in early spring, otherwise the canes are too dry and brittle, snapping off too readily when bent. A strong-growing vine pruned thus tends to produce watershoots somewhat freely; but this, under intense cropping, has advantages in affording ready means of replacing spurs which fail to respond after the pruning—an effect somewhat common with the Sultana.

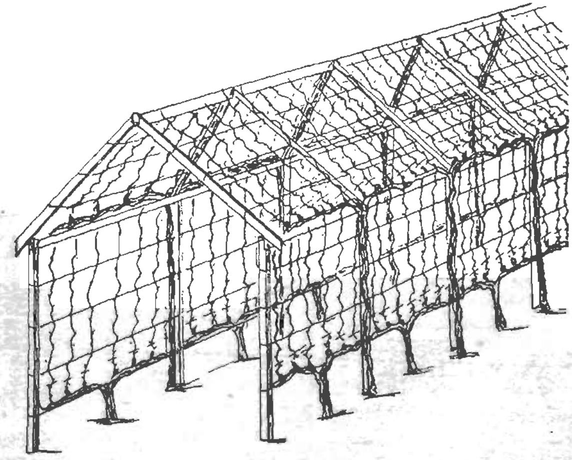


Fig. 231.—Vines Trained on a Gable-roofed Pergola. (The short cross lines indicate the positions for severing the canes each winter).

The Thomery spalier is adaptable to most vines when planted for the purpose of covering unsightly fences, high blank walls, training over lean-to structures, or pergolas for the formation of shady walks. In such cases several tiers of vines with stems of various lengths are utilised with ease.

HIGH TRELLISES.

In covering a high structure with trellised vines it becomes necessary to train a series of vines with stems of various heights, so that the rule of maintaining the fruiting wood upon a common level on each plant may be followed. To secure the necessary length of stem it sometimes takes several

seasons to grow a shoot to the required height. If the growth from the young vine does not ascend sufficiently far above this required height during the first summer, it should at the next winter again be pruned back to a spur of a couple of buds to induce a vigorous response, and only one shoot should be allowed to grow therefrom. This is tied up vertically, and as it passes the required height its point should be pinched out in the summer, as previously described, for the purpose of securing short-jointed wood with closely set buds upon it. This method, as previously explained, is followed only when the spaliers are being formed.

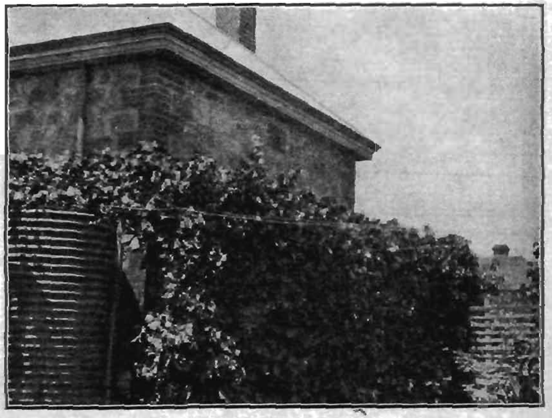


Fig. 232.

If a high vertical surface is to be covered, with vines of only moderate strength such as is depicted in Fig. 230, the method adopted there may be followed in a series of five vines. If, however, the soil be good and the grower has a wall not more than about 16ft. high to cover the series may be reduced to two vines, *i.e.*, a short-stemmed vine alternating with a long-stemmed one throughout, as is shown in Fig. 218A and the shaded walk or pergola drawn in Fig. 231.

In designing any of these trellises the lowest vines should have stems from 1ft. 9in. to 2ft. in length, but not less. In the case of gable or lean-to structures shown at Figs. 231, 232, 233, 234, the stems of the highest should be trained along the eaves. The annual shoots will then rise each season from the lowest vines and cover the side or vertical face, and those from the higher

extend from the eaves to the apex. If the vines be spur-pruned types, each season's winter pruning is reduced to the simplest form, consisting merely

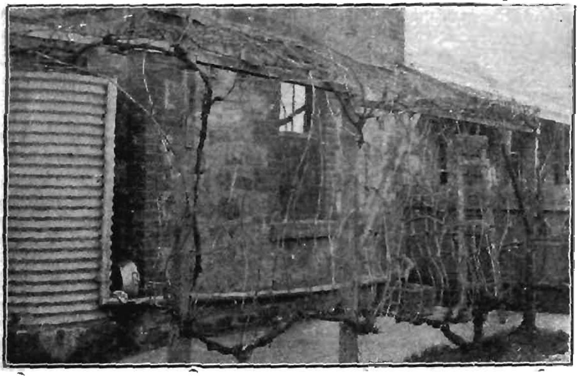


Fig. 233.—Vines in Fig. 232 before Winter Pruning.

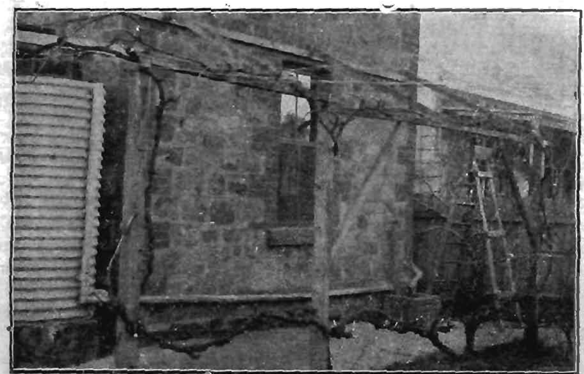


Fig. 234.—The Vines in Figs. 232 and 233 after Winter Pruning.

of cutting the annual growths back to spurs situate close down upon the horizontal arms, renewing any from watershoots from time to time as the case demands. Fig. 232 represents a cottage wall shaded by a lean-to structure

carrying one short-stemmed spalier made of a Gordo Blanco vine 18 years old. This vine looks badly designed, but its stem has been buried by filling up the land, and the main arms raised on to higher wires than those upon which they were originally framed. This can be more readily understood by referring to Figs. 233 and 234, which show this vine without leaves, before and after pruning respectively. On this trellis the central post supports a spalier which was also divided for a lower trellis, thus causing the main arms to be badly placed also. This vine is a Waltham Cross, and is rod and spur pruned, the fruiting rods or canes being bent down, as seen in Fig. 234. The vines at the ends are of the Muscat Hamburg variety, trained as cordons and spur-pruned. These photographs serve to show how grape vines may, if trained on the principles outlined herein, be kept over a period of many years, not only in a fruitful condition, but each summer providing a perfect shade from the *ground upwards*, whilst, after they are pruned in winter, the walls or walks may receive the fullest volume of sunshine to warm and dry them.

CORDONS.

This term is applied to trellised vines which have one main arm only, produced from the main stem. Upon this arm the annual shoots are arranged in exactly the same manner as those upon the main arms of the spalier. For those varieties capable of carrying an extended arm in a well furnished condition the cordon is superior to the spalier, inasmuch as it is more simply formed, and the trouble of balancing the growths on each side of the main stem, more particularly after the vine is furnished with fruit wood, is avoided. Further, in exposed positions horizontal cordons may be trained with the prevailing wind, thus averting considerable buffeting and breaking off of the shoots in the early stages of their growth. Another advantage is that, whilst in the centre of the spalier there is over 1ft. of main arm space on which it is unsafe to permit any fruiting wood to grow, in the case of the cordon there is only half this length on each vine devoid of fruit wood, and that space is readily utilised by causing the terminal end of the main arm of one cordon to lengthen until it overlaps the bare space on the next. (See Fig. 241.)

There are many forms of cordons, known respectively as vertical cordons, oblique cordons, and horizontal cordons. In the vertical cordon the main stem is simply extended a little year by year straight up the vertical surface of a wall or other structure, and the fruit wood disposed at regular intervals along its length. This is a very difficult plant to control, for the reason that it violates the primary rule whereby it is possible to obtain an even diffusion of sap in the annual shoots.

Oblique cordons are so called because of the projection of the main stems or axes in an oblique direction. This is also clothed with fruit wood along its length, and it is likewise open to the objection raised against the vertical

cordon, viz., the difficulty of maintaining an even distribution of the sap to all parts of the vine, though usually not to the same degree as with the more vertical method. If planted in series against high trellises only the upper half of the stem on a vertical or oblique cordon is permitted to carry fruiting wood.

The forms of the cordon which have found most general acceptation in the vine-growing countries of the world are those possessed of a horizontal main arm, thus permitting with the least difficulty the most permanent results being obtained from the manipulation of the fruiting wood.

Horizontal Cordons.

The principal authorities on the training of the vine have described three types of horizontal cordons, viz., the Guyot, Sylvoz, and Casenave. The former, which is suitable to rod-pruned varieties only, may be briefly described as a short-stemmed vine, carrying one spur and a rod. The rod is bent down and fixed to a horizontal wire, and the side shoots from it are severely summer pruned. The growths from the spur are tied up to a vertical stake to assist their vigor. Each winter the rod of the previous year is cut away, and of the two shoots from the spur one is laid down for a fruiting rod, whilst the other—usually that one situate closest to the parent stem—is cut to a spur of two buds to provide the wood for next season's operations. This type has not met with the approval of Australian vignerons, being, it is said, not suited to our conditions.

The Sylvoz cordon consists of a main stem which is raised to the desired height and then bent over at right angles and produced from year to year along in a horizontal direction. The fruiting wood is pruned to spurs at first, but afterwards retained as rods only when the vine is fully formed. These rods are bent down sharply to a lower wire and tied pretty well in an inverted position, or at right angles from the main arm. The system appears simple, as each year the rods of the previous season which have fruited are suppressed back to the shoot nearest the main stem, and this is bent down as a rod to do duty as its parent did in the season just past. In practice, however, the attempts to bend the rods with sufficient abruptness to force the growth from the buds upon their lower or basal portions have resulted in a very large percentage of them snapping off. When not bent sufficiently the buds upon the terminal portion of the rod make the most growth; and, in fact, in spite of their inverted positions, seriously rob those situate nearer the main arm. Anyone practising this method of training would act wisely in allowing the rods to remain unbent until the sap has started in them, when they withstand sharp bends, and even twists, to a very much greater extent than in the dormant winter season. This system, like Guyot's, is suited to rod-pruned vines only. It needs a three-wire trellis,

and Mr. A. J. Perkins, formerly Government Viticulturist of this State, recommended the lower wire to be set 20in. above the soil; the middle one, on which the main arm is trained, 16in. higher; and the upper wire, to support the annual shoots, 20in. above the second wire. This means a trellis 4ft. 8in. above the soil, and in most places it would prove a very expensive structure.

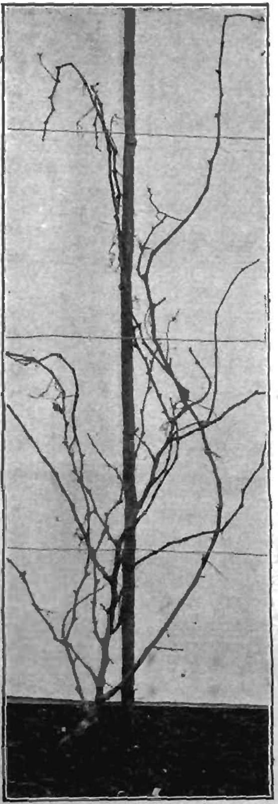


Fig. 235.—Two-year Old Vine, Unformed.

THE CASENAVE CORDON.

This is the form of cordon which has proved most appropriate for our conditions, and is gradually superseding all others. This cordon consists of a vertical stem grown to the height desired, and thence turned at right angles along a horizontal wire or support. Along its length, at intervals of 12in. to 15in., are disposed a series of rods and spurs on such varieties as need rod-pruning. If of a spur-pruned variety, the spurs are allowed to remain closer together, say, from 8in. to 10in. apart. If for rod-pruned kinds, set in open land, three wires are necessary in the trellis, arranged as for the Sylvoz cordon, the middle one carrying the main arm of the vine, the lower supporting the bent-down rods, and the upper the annual wood. In modifications, however, two wires only are sometimes used, as seen in Fig. 240, the rods being tied over to the wire which carries the main arm. If three wires are used, the bottom one may be 12in. above the soil, the middle wire 24in., and the upper one 12in. to 15in. above the second wire. In the case of spur-pruned varieties, two wires are sufficient—one to carry the main arm 2ft. above the soil and a second to support the annual shoots, stretched at about 12in. to 15in. above it.

FORMING THE VINE.

As in the case of all previously described vines, the newly-set plant is pruned to a short spur. During the next summer its growths are trained up a stake. If time be available for disbudding surplus growths,

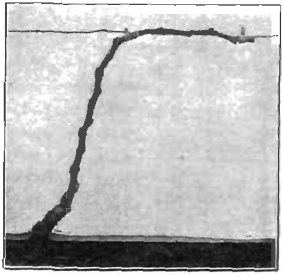


Fig. 236.—Two-year Old Vine Cordon-pruned.

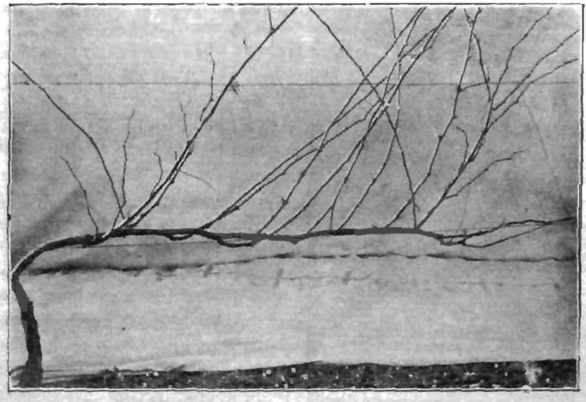


Fig. 237.—Strong Vine before Third Winter Pruning.

the energy of strong plants may be directed into one good shoot; and this, after passing the desired height for the stem, could be bent along the wire which shall carry the main arm. Usually, however, the vine is permitted to make a number of shoots and laterals

during the first summer, and 12 months after planting, when the second winter's pruning time arrives, the plant resembles the vine in Fig. 235. In such a case the growth of the strongest cane is sufficiently stout to permit the main arm being laid down; and in Fig. 236 this has been done, and about 1ft. of the arm has been laid along the wire, all other shoots being completely suppressed. When about to perform this work the cane which is to be saved as a main arm is bent down along the wire, and at the length where it is to be severed a bud situated on the *underneath side* should be selected as the terminal bud, and then the cane severed through the next node farther on; the object of this precaution being, as has been explained in connection with framing spaliers, to assure the formation of only a slightly *inverted* arch at the junction of the growths of the old and new extensions.

At the next winter's pruning the vine in Fig. 236 would probably possess half a dozen good canes, and of these the terminal one would be cut to about 15in. or 18in. in length and laid down for further extending the main arm,

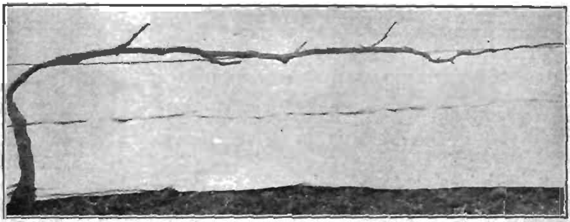


Fig. 238.—Vine in Fig. 237 after Third Winter Pruning.

whilst about two others would be pruned back to spurs of two buds each; the spur nearest to the main stem being at least 10in. out along the arm, whilst the second would be close up to the end of the first year's length of arm.

Fig. 237 shows a much stronger vine, which had about 3ft. of arm laid down the first year, and its third winter pruning (*i.e.*, two years after planting) is indicated in Fig. 238, and four spurs, with an extension rod about 18in. long have been saved. Each of these spurs will give rise to two shoots, and if it be a variety requiring to be rod-pruned, next winter one on each spur will be reserved as a rod to produce the season's fruit, whilst the other will be cut back to a spur to make the necessary shoots for next season's work.

The vine may now be said to be formed, and the annual pruning consists of suppressing suckers, watershoots, and any superfluous canes along the arm bending down the canes or rods selected for fruit bearing, and pruning

to spurs those most suitably situated for maintaining the shape of the vine and restraining it within bounds. At the same time as this is in progress the terminal growth extends the arm slightly from year to year, until such

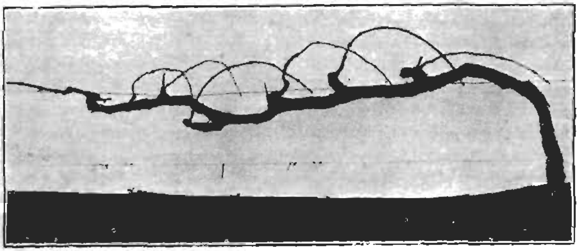


Fig. 239.—Cazenave Cordon of Moderate Strength Rod-pruned.

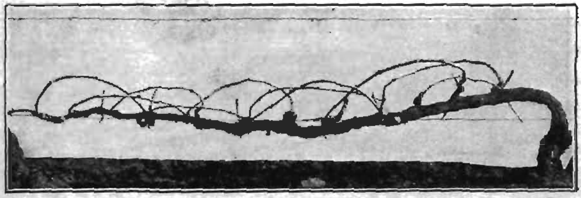


Fig. 240.—Cazenave Cordon. A very Strong Vine with Numerous Rods.

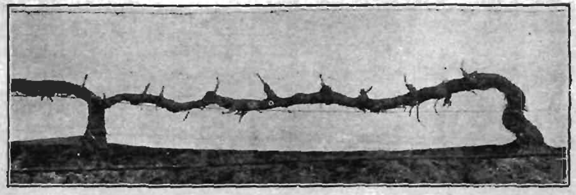


Fig. 241.—Horizontal Cordon (Spur-pruned) Overlapping next Vine.

time as the main arm has overlapped the bend of the next vine and conjointly made the trellis one continuous line of main arms furnished with annual growths.

Figs. 239 and 240 illustrate these facts; the first-named being yet in the process of extension towards the next vine, and the latter, having just about

linked up the chain of cordon arms, is provided with abundance of rods to use up its very apparent vigor of vegetation. It will be noted that in Fig. 240 the continuation has been pruned to a mere spur only. It may be remarked that should *time permit during the summers in which the* vine is undergoing its processes of extension, the terminal shoot may be bent down to a horizontal position whilst it is growing, as this favors the formation of a more perfectly straight main arm than is possible by the use of winter pruning alone.

In Fig. 241. a matured design of the spur-pruned Casenave cordon is shown. The overlapping by the terminal of the main arm over the butt of the next

Fig. 242.—Cazenave Cordons in the Foreground; Bordelais Spaliers in Distance.

vine is also noticeable. This is the type now widely followed by growers of the Zante currant when submitted to the operation of cincturing or ringing at the period of blossoming, it being found that this vine, under such training, produces abundantly upon spurs carrying from two to four buds.

Fig. 242 gives a general view of trellised vines in the vineyard at Roseworthy Agricultural College. In the foreground Casenave cordons are to be traced, and the distance is filled with Bordelais spaliers. The attention of the reader is incidentally called to the fine cover crop of field peas being grown between the rows of vines to be ploughed down for green manure.

It may be mentioned, in passing, that cordon-trained grape vines, such as are described herein, may be used for the purpose of shading covered

walks and bare walls with equal success to the spalier forms and with much less trouble to the grower. In setting out the plants they should be placed in series of two, three, or four vines, as the height of the structure to be covered may demand, keeping in mind that the greater the number in the series the closer the plants should be set to each other.

Whatever number be selected the pruner should bear in mind that the golden rule of permanently successful training consists in establishing and maintaining upon a common level all the fruiting wood grown from any one vine, so that the sap may be distributed evenly to all parts.

The following varieties are recommended for trellising, as spaliers or cordons, over ornamental structures and upon high surfaces, because they display much persistency in retaining their spurs or secondary arms in regular order upon the permanent arms:—Black Frontignan, Black Hamburg, Doradillo, Grand Turk, Muscat Gordo Blanco, Muscat Hamburg, Red Prince, Royal Ascot, Sweetwater, Temperano, Wortley Hall, Crystal, Red Frontignan, Zante Currant. Of these the most suitable for forming the higher tiers of any series are Grand Turk, Red Prince, Sweetwater, Royal Ascot, Crystal, and Zante Currant.

SPRING AND SUMMER PRUNING.

Under this heading is classified all of those operations performed upon the vine after the period of vegetative activity begins. Taken in general there is a great diversity of opinions expressed by those engaged in the cultivation of grape vines respecting the necessity or even the utility of the practice. The practical men usually contend that it is necessary from economical reasons, putting forward that it is desirable to restrict the spread of the plants, or that it is needed to increase the setting or the size and color of the fruits. On the other hand, the more scientifically informed argue that not only is it not necessary and avoidable but distinctly injurious, if pursued for a lengthy period on the lines frequently adopted by vignerons. As the object of these notes is to assist in guiding the beginner along safe lines from the inception of his vine-growing, the writer unhesitatingly supports the side taken by the scientific men.

The part played in the economy of a plant by its green chlorophyll bearing portions should ever be kept in mind in all of the practices followed in vine cultivation. This consideration should even begin with the setting out of the plants, inasmuch as the judgment displayed in deciding the distances apart to place them will aid materially in rendering unnecessary much of the rough restriction of the growing canes now practised.

The leaves are, in function, the lungs and stomach of the plant, and in so far as its powers of respiration and assimilation are reduced by their removal so is the vine checked and weakened. *In the leaves is manufactured the*

starch, which is afterwards changed into sugar, a large portion of which finds its way into the fruits. Hence, the removal of healthy leaves retards the production of this very essential constituent.

Spring and summer pruning as practised here has been said to consist of three operations, viz.—(*a*) Disbudding, (*b*) pinching, (*c*) topping.

The first-named is defined as the removal in the very early stages of their development of all watershoots and other superfluous growths from amongst those found upon the fruiting canes. This is done with a view to concentrating the energies of the plant into those shoots deemed to possess the greatest present and potential value. It is applied also in connection with the training of vines under certain systems, such as in the manner described in these notes, in shaping the various spaliers and cordons.

The second operation, called "pinching," has been utilised in the direction of removing the sappy terminal points of the flowering canes to induce the setting of the fruits through the temporary check which such an action imposes at that period upon the vigor of the shoot. It is also used in stopping the leader in the formation of the main arms of the Thomery spalier.

The third operation, which has been referred to as "topping," consists of an indiscriminate lopping off of the upper portions of the growing shoots to a length of several inches and not infrequently to that of a foot or more. This procedure has been followed largely to enable the implements of tillage to pass without hindrance between the rows of vines. The practice has been widely denounced by those whose opinions are entitled to respect. Quite apart from its weakening influences upon the vines, anyone who, in the winter following upon its application, proceeds to prune the vines is met with a tangle of laterals of a particularly annoying character. Should the variety need rod-pruning the results of such a topping, unless performed early in the growing season, are disastrous to his chances of securing good fruiting canes.

In respect to these operations the beginner is advised to proceed with caution upon the following lines :—

DISBUDDING.

In the production of some sorts of table grapes and Muscat raisins it has been found necessary, in order to secure fruit of the highest quality, to prune the vines in winter to a limited number of spurs, each possessing one or two buds only. The effect frequently observed to follow upon this procedure is the starting into activity of a fairly large proportion of watershoots on the old wood, as well as buds in the angles made where the spurs join the older limbs. In manipulating the watershoots, all of those arising from the main stem, whether they emerge above or below the soil line, should be rubbed

away while yet in the brittle stage. Those starting from any of the main or secondary arms should be considered in the light of their possible value in renewing the arm, as explained in the earlier chapters on winter pruning. Should there be indications of the necessity for their early use, such as are well situated should be saved until the next winter season determines this point. The shoots arising out of the angles where the spurs join the older wood or secondary arms are not truly watershoots, and their closer junction with the old wood may render some of them of value to work upon at the next winter's pruning. When fruiting canes are twisted around the wires, as in Figs. 221 and 229A, those shoots showing no flower bunches are sometimes disbudded early in the summer

PINCHING.

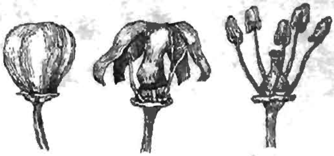
This operation does appear to secure a certain amount of increase in the setting of the berries on the bunches formed upon some grape vines, and the check administered to the shoots is so mild and temporary in character as to render its devitalising influences a negligible factor.

TOPPING.

Where the vines are pruned with good judgment in the winter, and disbudding has been reasonably applied, there is seldom any need for topping, unless the plants are growing strongly in rich soil. Shoots which threaten to spread

Fig. 243.—Vine Stem showing Cincture.

across the spaces between the rows should be bent or tied to the trellis wires In the case of bush vines only the extreme ends need cutting, if any shortening be found necessary to permit unrestricted use of the tillage implements after midsummer.



(1) (2) (3)

Fig. 244.—Stage of Flowering when Cincture is applied is indicated in (2) and (3).

CINCTURING OR RINGBARKING.

This important method of restricting the activities of some varieties of grape vines, to induce a more consistent setting of the berries upon the bunches, is a *form of spring pruning*. The *cincture*, which consists of completely removing an extremely narrow ring of bark from around the stems, main arms, or even canes of the vines, is performed when the corollas are falling

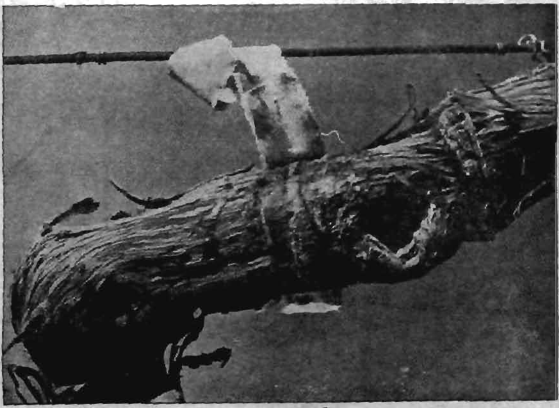


Fig. 245.—Cinctured Stem showing Waxed Bandage and Cincture callused over in Six Weeks. Note old, badly-healed cincture higher up.

(see (2) and (3) Fig. 244) from the blossoms. The *immediate effect* of this is to impede to a large degree—for a short period only—the return of the elaborated sap from the foliage to the root system and thus prevent or check *the rapid extension of the roots, which naturally takes place during the first* few weeks of returned animation in the spring. This retention of the elaborated sap causes the stem immediately above the cincture to become increased

(*a*) (*b*)

Fig. 246.—Comparison of Fruit Setting on (*a*) Cinctured and (*b*) Uncinctured Vines.

in diameter, and apparently this meagre circulation of sap allows the berries to make good their connection with the pedicels and become an integral part of the bunch. It is desirable that this checking of the sap should not be of too prolonged a character. Experimental tests indicate *that it is essential* the disconnected tissues should again bridge over the wound, and thus enable the circulation to resume its customary course at an early date. If a complete ring of bark, not more than one-sixteenth to one-twelfth of an inch wide be *removed (as shown in Fig. 243), the chances of this taking place quickly* are increased.

Some currant-growers claim to have obtained equally good results from the use of a simple incision made by passing a sharp or even notched knife around the limb as deeply as the sap layer, but the general opinion favors the removal of the narrow ring of bark. To secure the rapid bridging of

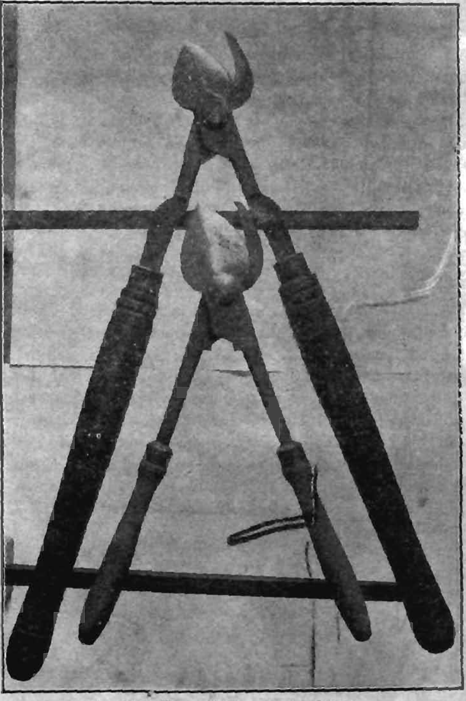


Fig. 247.—Types of Vine-pruning Shears.

the wounded tissues it is desirable the cut section should be protected against the drying effects of sun and wind. Some growers do this by means of strips of bagging or rag bound around the cinctures. Better results, however, may be secured by the use of strips of calico about an inch wide which have been steeped in grafting wax, as indicated in Fig. 245.

In the tests from which these figures were made the waxed bands enabled the healing callus to completely fill the wound within six weeks, and the nourishing of the fruit and foliage then proceeded in a normal fashion. Glancing at Fig. 245, just above the cincture which has been covered by a waxed band, may be seen the cincture of the previous season, which had not been covered, and it has become dry, and only partially healed.

Currant vines cinctured too severely indicate the devitalising effect of the operation in failing to ripen the terminal portions of the canes, sometimes for several feet in length. In Fig. 246 the comparative effects of the cincture in causing the setting of the berries on bunches of the Zante currant is shown. Although primarily applied to the Zante currant, the cincture has been used upon Sultana and Gordo Blanco vines with promising results in the setting of the fruits. In the case of the former, however, it has been chiefly applied to the fruiting canes, as opposed to being made upon the main stems or main arms as is done on the Zante currant.

VINE-PRUNING SHEARS.

Fig. 247 depicts two types of shears used in vine pruning. Both of these have wooden handles, to enable the pruner to retain a firm grip when severing strong shoots. Another form of the lower pair of vine shears which is used in this State, but not illustrated here, is not provided with these wooden grips, but has simply the rounded steel handles, the end of one being drawn out a little longer into a flat steel chisel-like point, which is sharpened. This chisel is designed for stabbing off watershoots or suckers. In cold weather when the hands of the pruner are chilled, he experiences some difficulty in retaining a good hold of these steel handles, and it is a common practice to sleeve a short piece of ½in. rubber hose over each of the steel handles to make a non-slipping grip.

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